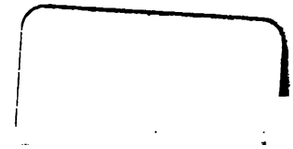

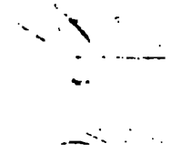

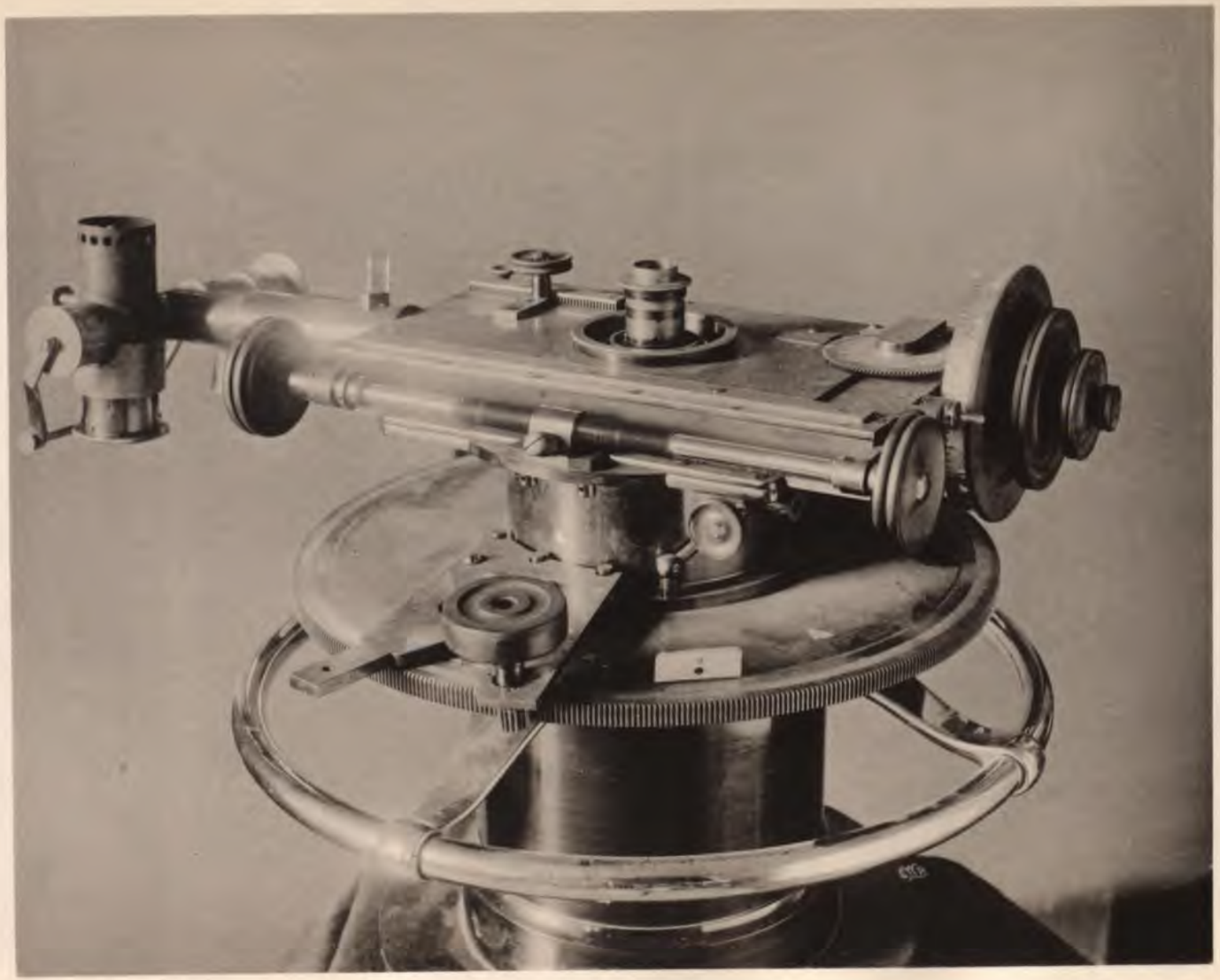

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ORGANIZATION OF THE LICK OBSERVATORY.

Hon. T. G. PHELPS, Hon. C. F. CROCKER, Hon. H. S. FOOTE,

Committee of the Regents on the Lick Observatory.

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R. H. TUCKER, JR.,	*Astronomer.*
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DOUBLE STAR OBSERVATIONS

MADE WITH THE

THIRTY-SIX-INCH AND TWELVE-INCH REFRACTORS

OF THE

LICK OBSERVATORY,

FROM AUGUST, 1888, TO JUNE, 1892.

By S. W. BURNHAM.

TABLE OF CONTENTS.

DOUBLE STAR MEASURES MADE WITH THE 36-INCH AND 12-INCH CLARK REFRACTORS OF THE LICK OBSERVATORY IN 1889, 1890, AND 1891.

By

S. W. BURNHAM.

INTRODUCTION.

The following measures of miscellaneous double stars were principally made during the three years ending December, 1891. A few measures were made in the latter part of 1888 and in the early part of 1892. The greater part of this work has been done with the large telescope. Although many of these pairs are readily seen with the 12-inch, the measures certainly have a higher degree of accuracy when made with the more powerful telescope, and for that reason it has been used in this work as far as possible. Most of the extreme southern pairs have been observed with the 12-inch, on account of the greater convenience in working at low altitudes.

THE TELESCOPES.

The method of observing has been sufficiently referred to in the introductions to the several catalogues of new stars. It has been consistently followed throughout the work. As to the optical perfection of both telescopes, it is only necessary to refer to the work itself, and particularly to the discoveries made here, which afford the highest and most satisfactory proof of the superiority of these objectives in defining-power, as well as light-power. During the first three years covered by these observations, the objective of the great telescope was not adjusted or changed in the least. In all this time the star discs have been so perfect under the highest powers, when the atmospheric conditions were suitable, there has been at no time anything to indicate any desired improvement in the adjustment of the object-glass. The telescope has always been in condition to do its best work, and all that could be expected of it without any loss of time on the part of the observer. It has more than satisfied the severest tests which could be applied, and the highest expectations concerning its performance have been realized. It is a monument to the genius and skill of the unrivaled opticians, ALVAN CLARK & SONS, to whom the progress of astronomical work all over the world is so largely indebted.

THE MICROMETER OF THE 36-INCH REFRACTOR.

The micrometer of the 36-inch telescope was made by FAUTH & COMPANY, of Washington, and is probably the largest and most massive instrument of the kind ever made. Its appearance and general construction will be seen in the photograph, reproduced as a frontispiece to these observations. Its weight is about 40 pounds; diameter of circle, 12 inches; micrometer screw-box, 10 by 5½ inches; diameter of graduated screw-head, 4 inches. The rotation of the box in position-angle is effected by two pinions, on opposite sides, which engage with teeth cut on the edge of the large circle. These pinions are provided with large milled heads. One of them is shown in the photograph on the front side of the micrometer. This method of rotating the wires in angular measures has great advantages in practical work over the old plan of doing it by a clamp and tangent-screw, which is much too slow. To get the best result in measuring difficult objects, it is essential that the wires should have a quick movement. The micrometer-box, with the system of wires, is shifted longitudinally by the long screw in front of the box, with a milled head at each end. In making measures, one of the pinions in setting for the angle, and the micrometer-head in distances, are always worked with the right hand, and the bisecting-screw invariably with the left. It will be seen that in every position of the telescope, and in every position of the wires with respect to angle, the several parts are conveniently placed to be used in this manner by reason of the opposite pinions and the double-headed bisecting-screw.

The illuminating apparatus is that devised by me in 1881, and which I have used altogether in double-star work since that time.* By virtue of the suspension of the lamp, and its motion on two axes at right angles to each other, the lamp always remains vertical, and in the same position, so far as the light is concerned, with reference to the wires. The illumination is therefore constant throughout their entire rotation. The amount of light can be varied at pleasure, or cut off entirely, by turning the end of the tube, which is a continuation of the first axis of the lamp. Red light is nearly always used on the wires, the light from the lamp passing through a slip of red glass in the large tube, near the end of the micrometer-box. In this way the wires can be perfectly illuminated, without interfering in the least with the visibility of the faintest object, which can be seen at all with the light entirely extinguished.

The micrometer-screw has about 32 threads to the inch, and one revolution, as

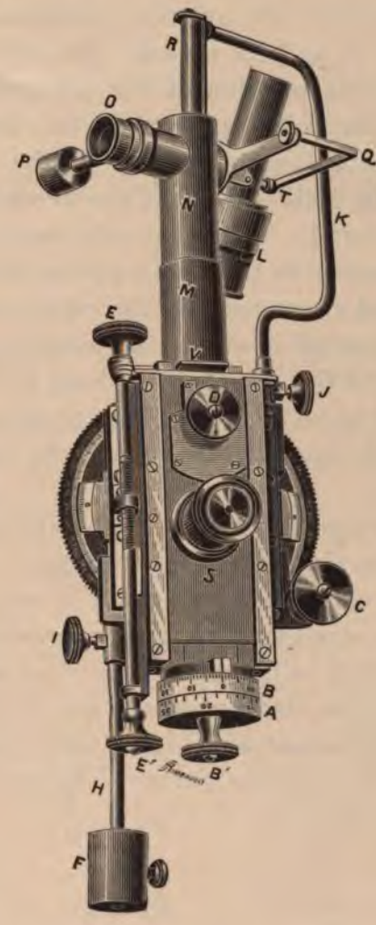
determined from transits and measures of differences of declination, is assumed to be 9″.90. All double-star measures are by double distances, and therefore the reading for the coincidence of the wires has been a matter of no consequence. For the sake of convenience in checking the opposite readings, whenever new wires have been put in they have been made to coincide substantially with zero divisions on the micrometer-head. As the micrometer is taken off once a week, or oftener, to make way for other attachments, it has been necessary to replace the wires many times during the course of this work. The revolutions of the micrometer-screw are read on the horizontal dial attached to the box, near the divided head of the screw.

The positive eye-pieces used with the micrometer give magnifying powers of 360, 520, 700, 1000, 1500, 1900, and 2600. The nominal values of these eye-pieces were about 25 per cent higher, but they were measured by Mr. KEELER, and the results found which are given above. The lowest power has been used only in measuring comparatively distant stars. For close stars, where the distance is not more than 0″.25, one of the last three powers has been employed, the selection depending somewhat upon the steadiness of the air.

THE MICROMETER OF THE 12-INCH REFRACTOR.

The micrometer of the 12-inch is, in all essential respects, a duplicate of the other. This is the first micrometer to which the illuminating device was permanently attached. It was made by CLARK & SONS, in 1881, following the plan which resulted from experiments with the micrometer of the Washburn Observatory. This method of bright-wire illumination was fully described, with an accompanying illustration of the 12-inch micrometer, in *Monthly Notices, R. A. S.*, for March, 1882. The cut and description are reproduced here, as the construction and working of the device can be easily seen by reference to the lettered parts.

The micrometer is of the usual form made by the CLARKS, *B* being the graduated head of the micrometer-screw, and *A* another graduated head turning on the same axis for giving the whole revolutions of the screw; *C* is the head of a pinion attached to the plate under the micrometer-box, and gearing into the teeth of the rigid circular plate containing the position-circle, for moving the wires in position-angle; *D* is the head of another small pinion for sliding the eye-piece over the wires; *E E'* are heads of the bisecting-screw for moving the whole system of wires and the box *S* in a direction parallel to the micrometer-screw, and at right angles to the wires. The light from the lamp *L* is reflected by a mirror in *N*, and passes down that tube and through *M*, and then through a hole in the end of the box to the wires. A condensing lens is placed in *N*, for the purpose of concentrating the light on the wires. On the opposite side of the wires, towards the micrometer-head, a small reflector is placed, which reflects the light back, thereby symmetrically illuminating the wires on both sides. The lamp swings freely on its axis in the line of *OT*, but always maintains a vertical position, whatever may be the direction of the wires or the pointing of the telescope. The tube *N*, with the lamp and its attachments, has an axle *R* supported by the fixed arm *K*. The bearings *T*, and axle of the lamp, are kept always horizontal by the weight of the counterpoise *P*. The tube *M* is fixed to the micrometer-box, and projects loosely over *N* far enough to allow for the necessary movement of the box by the bisecting-screw *E*. The supporting arm *K* is attached by the set-screw *J*, not to the box, but to the plate underneath it, so that the weight moved by the bisecting-screw is not increased at all by the illuminating apparatus. Attached to the same plate, on the opposite side by a set-screw *I*, is the rod *H*, bent so as to be thrown forward out of the way of *E'* and *B*, with a weight *F* to balance the weight of the



lamp attachments. The whole device can be instantly detached when desired, by loosening the screws *I* and *J*. In the tube *M* is a slot *V*, in which is placed a slip of red or other colored glass, held in any desired place by a light spring pressing against it. All or any part of the light can be made to pass through the colored medium. The mirror in *N* is attached to a tube which slides into the tube *O*. By turning this tube by the milled edge projecting at *O*, the inclination of the mirror may be varied to any extent, and the light reduced from the maximum amount until the wires become invisible. By turning the mirror 90° or more the light is entirely shut off. It will be seen that the lamp can revolve freely through the bent arm *Q*; and the whole movable part of the device, lamp, arm *Q*, and counterpoise *P*, can turn through the supporting arm *K*, the lamp at all times remaining vertical, and in exactly the same position with respect to the wires. It might at first be supposed that the lamp, or some of the parts, would be in the way of the observer. I have never found it so in practice, and although it is but a few seconds' work to either attach or detach it, I have very rarely removed it, whatever might have been the use of the telescope at the time.

It is important to preserve the relative positions of the micrometer-head, bisecting-screw, and pinion C, as here shown. No other arrangement will be as convenient. In every possible position of the micrometer, the necessary use of both hands at the same time will be found to be convenient and easy for the observer. Naturally the more delicate motions of the micrometer-screw and the pinion will be effected by the right hand, and the corresponding movement of the bisecting-screw by the left hand. When the micrometer-box is anywhere near a horizontal position with respect to the observer (the wires at right angles to the line joining the eyes), C and E are used by the right and left hands, respectively, in measuring angles, and B' and E in measuring distances. When the box is more nearly vertical with respect to the observer, the head E' of the bisecting-screw will be worked by the left hand in each case. The convenience and practical value of this arrangement can only be appreciated by one who has used the old plans, and then tried this.

With respect to the practical working of the illumination, I will briefly say that it has proved a complete success in every respect. Any object that can be seen under any circumstances, however faint, can be well and accurately measured. There is no such thing as a star too faint for measurement, if it can be seen at all. A very feeble light is sufficient to illuminate the wires perfectly for any object. I believe far better results can be obtained by the use of bright wires in a large part of the most desirable and important double-star work, than is possible by the same observer using a bright field, and that sooner or later it will be generally used in all micrometrical observations.

MICROMETRICAL MEASURES.

β 1014.

R. A. $0^h\ 1^m\ 23^s$
Decl. $+31^\circ\ 0'$

1891.689	336°.6	1".42	7.0 . . 12.0	36
.692	334.2	1.57	7.0 . . 12.5	36
.711	337.0	1.50	7.0 . . 13.0	36
1891.70	335.9	1.50	7.0 . . 12.5	

There are no other measures of this pair.

Σ 2.

R. A. $0^h\ 2^m\ 36^s$
Decl. $+79^\circ\ 3'$

1890.785	173°.1	0".27	7.0 . . . 7.0	36
.802	179.9	0.30	6.6 . . . 6.6	36
.879	178.3	0.30	6.5 . . . 6.8	36
1890.82	177.1	0.29	6.7 . . . 6.8	
1892.386	168.3	0.30		36

This pair has been single, or non-measurable, for the last thirty years. The angular motion since the last measure of $O\Sigma$ in 1858 has been more than 150°. It is not a difficult pair now, and the distance should be steadily increasing, with but little change in the angle. The measures indicate a period of about four hundred and fifty years, with a maximum distance of 1".

β Cassiopeiae.

R. A. $0^h\ 2^m\ 43^s$
Decl. $+58^\circ\ 20'$

1889.589	189°.4	22".61	2.0 . . 14.0	36
.592	188.9	22.54	. . 13.5	36
.594	189.3	22.74	. . 13.5	36
1889.59	189.2	22.63	. . 13.7	

This very minute companion was detected, I think, by Mr. ALVAN G. CLARK. I do not know with what aperture it was first seen. I have a recollection of his mentioning some years ago that he had seen a faint companion to *β Cassiopeiae*. The Struve 30-inch refractor was probably the instrument used.

β 483.

R. A. $0^h\ 2^m\ 49^s$
Decl. $+40^\circ\ 11'$

1891.689	45°.4	2".79	7.5 . . 12.0	36
.692	43.9	3.07	6.8 . . 11.5	36
.711	43.0	3.00	7.2 . . 11.5	36
1891.70	44.1	2.95	7.2 . . 11.7	36

β 484.

R. A. $0^h\ 3^m\ 30^s$
Decl. $+51^\circ\ 22'$

1890.898	153°.0	1".88	7.5 . . 11.5	36
.900	156.2	2.01	7.7 . . 11.5	36
.911	154.6	1.84	7.8 . . 12.0	36
1891.689	155.8	1.85	7.5 . . 11.0	36
.692	155.3	1.90	7.5 . . 12.0	36
.731	157.2	1.83	7.8 . . 11.5	36

The mean results of the two sets of measures are:

1890.90	154°.6	1".91	7.7 . . 11.7
1891.70	156.1	1.86	7.6 . . 11.5

β 253.

R. A. $0^h\ 4^m\ 5^s$
Decl. $+57^\circ\ 51'$

1888.733	50°.6	0".68	8.5 . . . 8.5	12
9.553	50.2	0.66	8.0 . . . 8.2	36
9.556	51.6	0.60	8.3 . . . 8.3	36
1891.504	48.2	0.58	8.2 . . . 8.3	36
.537	46.3	0.63	8.4 . . . 8.5	36

Giving the following means:

1889.28	50°.8	0".65	8.3 . . . 8.3	3 n
1891.52	47.2	0.60	8.3 . . . 8.4	2 n

The only prior measures are:

1875.95	49°.9	0".42	Δ	5 n

β 485.

R. A. 0h 4m 30s
Decl. + 58° 6′

1889.537	306°.9	0".46	8.5 . . . 8.6	36
.553	307.8	0.42	8.4 . . . 8.5	36
.556	307.5	0.45	8.5 . . . 8.5	36
1891.504	308.0	0.42	8.5 . . . 8.6	36
.537	307.2	0.45	8.5 . . . 8.5	36

These with a prior set of measures are all the observations:

1878.17	148°.5	0".41	β	2 n
1889.55	307.4	0.44	β	3 n
1891.52	307.6	0.43	β	2 n

β 255.

R. A. 0h 5m 38s
Decl. + 27° 45′

1890.862	96°.7	0".70	7.5 . . . 8.0	36
.879	99.0	0.53	7.5 . . . 9.0	36
.882	97.9	0.53	7.6 . . . 8.3	36
1890.87	97.9	0.59	7.5 . . . 8.4	

Probably not much change yet, as Δ found:

1875.76	99°.0	0".38	De	4 n

β 864.

R. A. 0h 6m 40s
Decl. + 34° 40′

1891.689	133°.8	1".98	8.4 . . 11.5	36
.692	137.0	2.03	8.2 . . 11.5	36
.711	138.3	2.07	8.5 . . 11.5	36
1891.70	136.4	2.03	8.4 . . 11.5	

β 998.

R. A. 0h 7m 30s
Decl. + 5° 55′

1891.657	115°.4	1".31	8.5 . . . 8.6	36
.692	113.7	1.15	8.2 . . . 8.4	36
.709	114.4	1.23	8.2 . . . 8.4	36
1891.68	114.5	1.23	8.3 . . . 8.5	

β 486. Ceti 33.

R. A. 0h 8m 19s
Decl. — 8° 27′

1888.914	5°.3	3".09	5.0 . . 11.0	36

β 1027.

R. A. 0h 8m 44s
Decl. + 20° 50′

1891.845	185°.9	1".60	7.5 . . 11.5	36
.854	186.8	1.56	7.7 . . 11.0	36
.856	189.4	1.49	8.0 . . 12.0	12
1891.85	187.4	1.55	7.7 . . 11.5	

Σ 13.

R. A. 0h 9m 25s
Decl. + 76° 17′

1889.323	91°.5	0".76	6.5 . . . 6.6	36
.392	89.8	0.87	6.0 . . . 6.1	12
.397	91.7	0.75	6.0 . . . 6.0	36
.512	93.7	0.86	6.5 . . . 6.7	12
1889.41	91.7	0.81	6.2 . . . 6.3	

Binary system, in slow retrograde motion.

β 487.

R. A. 0h 10m 18s
Decl. + 28° 38′

B and C.

1891.636	267°.0	2".25	8.8 . . 11.5	36
.638	266.1	2.53	9.0 . . 11.5	36
1891.64	266.5	2.39	8 9 . . 11.5	

A and B (= Σ 17).

1891.636	29°.7	26".95	8.2 . . .	36
.638	29.1	27.02	8.0 . . .	36
1891.64	29.4	26.98	8.1 . . .	

β 392 (B. A. C. 46).

R. A. 0h 10m 31s
Decl. + 60° 52′

1888.706	67°.9	19".71	6.0 . . 13.0	12
.709	68.8	19.41	7.0 . . 11.5	12
.711	67.8	20.28	. . 12.5	12
1888.71	68.2	19.80	6.5 . . 12.3	

No other measures of this pair.

β 393.

R. A. $0^h\ 12^m\ 12^s$
Decl. $-\ 21^\circ\ 48'$

	°	″		
1890.879	18.4	0.70	7.6 . . . 8.0	36
.893	17.5	0.73	7.5 . . . 8.0	36
.898	12.1	0.71	7.5 . . . 8.3	36
1890.89	16.0	0.71	7.5 . . . 8.1	

Change is uncertain.

β 1015.

R. A. $0^h\ 14^m\ 27^s$
Decl. $+\ 11^\circ\ 39'$

	°	″		
1891.636	120.1	0.53	8.5 . . . 8.7	36
.657	121.1	0.52	8.3 . . . 8.5	36
1891.64	120.6	0.52	8.4 . . . 8.6	

β 489.

R. A. $0^h\ 19^m\ 40^s$
Decl. $+\ 43^\circ\ 31'$

	°	″		
1891.636	178.5	3.30	8.2 . . 11.5	36
.638	182.4	3.40	8.3 . . 11.5	36
1891.64	180.4	3.35	8.3 . . 11.5	

OΣ 10 rej.

R. A. $0^h\ 21^m\ 16^s$
Decl. $+\ 15^\circ\ 22'$

1890.785	Neither star double. Good seeing.	36

The smaller star of this wide pair (237°:96″) at one time was supposed to be a close pair, but it was rejected by OΣ in the catalogue of 1850. Ma, in 1844, made a measure of it, marked "very uncertain." I found it single in 1878 with the 18½-inch, and at other times. Clearly there is no occasion for any further examination of this star.

H 1968.

R. A. $0^h\ 21^m\ 33^s$
Decl. $-\ 17^\circ\ 4'$

A and B.

	°	″		
1890.851	88.4	4.19	7.0 . . 9.5	36
.854	86.1	4.17	7.0 . . 9.3	12
.856	88.3	3.75	7.8 . . 9.5	12
.867	88.4	3.80	8.0 . . 10.5	12
1890.86	87.8	3.98	7.5 . . 9.7	
1891.788	89.5	3.93	8.0 . . 9.5	36
.791	88.8	3.92	8.0 . . 10.5	36
.810	88.6	3.94	8.0 . . 10.5	36
1891.80	89.0	3.93	8.0 . . 10.2	

A and C.

	°	″		
1891.788	121.5	93.16	. . 11.0	36
.791	121.2	93.79	. . 12.0	36
.810	121.2	93.13	. . 12.0	36
1891.80	121.3	93.36	. . 11.7	

The Proper Motion of H 1968.

By S. W. Burnham.

[From *Monthly Notices, R. A. S.*, January, 1891.]

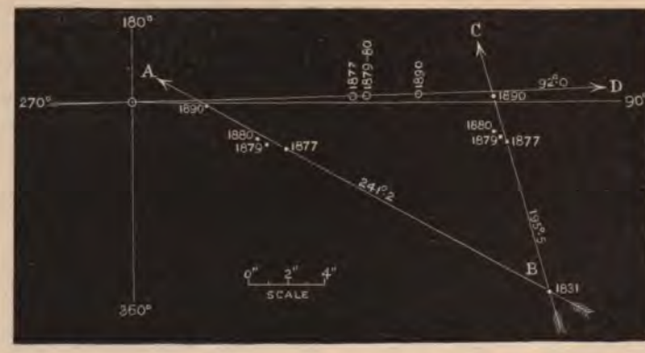
The double star *H* 1968 was first noted by Sir John Herschel with the 20-foot reflector at Slough, and entered in his fifth catalogue, published in 1833 (*Memoirs, R. A. S.*, Vol. VI.). The position-angle was measured and given as 61°.3, the distance being estimated as 20″±, and the magnitudes called 8 and 10–11. Naturally a pair of this class would not attract much attention, and, so far as I know, it was never looked at or referred to by any one for nearly half a century following. During the several years in which I was using the 6-inch Clark telescope at Chicago, I looked up hundreds of double stars to fix their places by identifying them in some of the star catalogues, to correct various apparent errors in magnitudes, descriptions, etc., and for other purposes, and among others examined the pair in question in December, 1875. The apparent change since Herschel's observation, particularly in distance, was very striking, and could not come from any ordinary error in the early description. I called the attention of Baron Dembowski to the probable change which had taken place, and he made a set of measures in 1876 and 1877, which will be found on page 347, Vol. I. of his observations. The name of the star is not given. Subsequently this pair was measured at Cincinnati, and still later by me with the 18½-inch refractor of the Dearborn Observatory. I have lately finished a series of measures at this observatory. So far as I know, these are all the measures that have been made anywhere. They are as follows:

1831.00	61.°3	20.″ ±	8.0	10–11	H	1 n
1877.23	73.1	8.50	7.1	10.0	De	4 n
1879.87	71.9	7.46			Cin	2 n
1880.09	73.6	6.94			β	3 n
1890.86	87.8	3.98	7.5	9.7	β	4 n

These measures should be sufficient to determine the character of the motion. We have no means of ascertaining the exact time when HERSCHEL measured the angle; but as he states the observations of the stars comprised in his fifth catalogue were made in the years 1830 and 1831, I have assumed 1831.0 as the most probable date, and that is near enough for the purposes of this investigation.

This star, according to ARGELANDER, has a proper motion of 0″.356 in the direction of 92°.6; but it has been shown recently (Stumpe, Ast. Nach., No. 2999) that from an error in R. A. in one of the catalogues, this value is too large, and that the annual movement is 0″.252 in the position-angle of 92°.0. Laying down the measures given above, it is apparent that this proper motion entirely fails to account for the motion of the small star, which makes a large angle with the line of the motion of the principal component. follow: Either this proper motion is erroneous, or the smaller star has a proper motion of its own, for it is evident that no question of orbital motion can arise in this case. The apparent motion of B during the interval of 13.63 years between the measures of 1877 and 1890 is 4″.75, or at the rate of 0″.35 per annum, in the direction of 241°.2. Evidently, if this star is fixed, the proper motion of A given above is wrong, and should be 0″.35, in the direction of 61°.2. This would give some change in declination, instead of placing it substantially all in right ascension. It does not seem probable that so large an error exists in the recognized proper motion.

On the other hand, if the motion of A is sensibly correct, the real motion of B can be easily determined from the positions of that star on the line BC, which are plotted with reference to the successive places of A along the line D at the several epochs, determined by the annual proper motion of 0″.252. In other words, these places are the actual positions in the heavens of the two stars at the several dates upon the assumption that the larger star has a yearly movement of 0″.252 in the direction of 92°.0. In that case B has an annual motion of 0″.18, in the direction of



The accompanying diagram shows the several positions of the stars at the dates given. The original diagram was made on a scale of 2″ to one inch, and then photographed down to the size given here. The position-angles were accurately plotted to the tenth of a degree, and the distances to the second decimal place. The positions on the line AB are those of the small star, with the principal star considered fixed at the central point. If the smaller star were really fixed, then of course this line should be parallel with the line D, which is the direction of the proper motion of the other star. One of two things must certainly 195°.5. Both of the lines A and C are drawn through the positions given by the measures of 1877 and 1890, as they are made up of more individual observations, and will, I think, give a more reliable direction than could be derived from all the measures. In the inferences drawn from these measures no use is made of the approximate measures of HERSCHEL, but we can see what the position-angle and distance should have been in 1831, by both assumptions of proper motion. At that time B must have been 24″ distant, in the direction of 65°.5, which is as close an agreement with HERSCHEL'S observation as could be ex-

pected. The minimum distance between the stars of 1″.8 will be reached about 1901, after which they will slowly separate.

The principal star is *Lalande* 593, and its place (1880) is:

R. A. $0^h\ 21^m\ 35^s$
Decl. $-\ 17^\circ\ 4'$

The magnitude is variously estimated. In addition to the magnitude given in connection with the measures, it is rated as 8 by LALANDE and GOULD, and 7.3 by SCHÖNFELD.

Mount Hamilton, Dec. 5, 1890.

β 107.

R. A. $0^h\ 24^m\ 28^s$
Decl. $+\ 62^\circ\ 14'$

1891.504	358.0	4.42	8.0 . . 9.3	36
.537	359.6	4.47	8.0 . . 10.0	36
1891.52	358.8	4.44	8.0 . . 9.6	

Ho. 212. 13 Ceti.

R. A. $0^h\ 29^m\ 3^s$
Decl. $-\ 4^\circ\ 15'$

1890.785 Cannot see any trace of duplicity in the large star. Tried all powers; seeing fairly good.

1891.575 Large star, perfectly round. Fine seeing.

1891.597 Round with 1500.

HOUGH, with the Chicago refractor, thought this was a close pair (90° : 0″.3).

As a wide pair this is β 490.

1891.575	58.8	34.14	5.0 . . 14.0	36
.597	58.8	33.46	5.5 . . 14.5	36
.657	59.2	33.57	6.0 . . 14.0	36
1891.61	58.9	33.72	5.5 . . 14.2	

0Σ 15.

R. A. $0^h\ 29^m\ 14^s$
Decl. $+\ 48^\circ\ 22'$

1890.879	302.9	0.20	7.5 . . . 8.5	36
.882	301.0	0.11	7.0 . . . 8.5	36
.898	301.0	0.15	7.3 . . . 8.0	36
1891.692	304.6	0.17	8.0 . . . 8.6	36
.711	300.3	0.12	8.0 . . . 8.5	36
.733	301.5	0.14	7.5 . . . 8.5	36

These two sets of measures give:

1890.88	301.6	0.15	3 n
1891.71	302.1	0.14	3 n

This star seems to have been rejected by 0Σ as being really single. Apparently no one but MADLER has ever previously seen it double. He gave 97°.3 : 0″.3 ± (1851.7), and noted it as single the following year. It was very doubtful to De, 1865. I could see no certain elongation with the Hanover 9.4-inch in 1874, and found it single with the Chicago 18½-inch in 1879, and had come to the conclusion that it was not a double star. Even if there has been no change, the closeness of the components would account for the failures heretofore to see it double. (See A.N. 3017.)

β 230.

R. A. $0^h\ 29^m\ 24^s$
Decl. $+\ 26^\circ\ 29'$

1891.689	322.5	4.03	8.6 . . . 9.0	36
.695	325.4	3.78	8.4 . . . 9.0	36
.733	324.5	3.91	8.3 . . . 9.0	36
1891.70	324.1	3.91	8.4 . . . 9.0	

β 1097.

R. A. $0^h\ 30^m\ 30^s$
Decl. $+\ 57^\circ\ 51'$

1891.537	248.0	0.52	8.0 . . . 8.2	36
.575	252.5	0.50	8.2 . . . 8.3	36
.581	254.1	0.43	8.0 . . . 8.1	36
1891.56	251.5	0.48	8.1 . . . 8.2	

β 395. Ceti 82.

R. A. $0^h\ 31^m\ 9^s$
Decl. $-\ 25^\circ\ 26'$

1890.802	114.4	0.77	6.0 . . . 6.1	36
.824	111.4	0.75	6.0 . . . 6.2	36
.832	111.9	0.69	6.0 . . . 6.0	36
1890.82	112.6	0.74	6.0 . . . 6.1	
1891.854	118.7	0.86	6.5 . . . 7.0	36
.856	119.7	0.75	7.5 . . . 7.5	12
.859	116.3	0.65	6.8 . . . 7.0	36
1891.85	118.2	0.75	6.9 . . . 7.2	

Certainly a binary, but the motion is slow. This star has a large proper motion, which,

according to ARGELANDER, is 1".436 in the direction of 90°.3.

β 491. δ Andromedae.

R. A. $0^h\ 32^m\ 54^s$
Decl. $+\ 30°\ 12'$

1888.706	300°.2	27".05	. . 13.0	12
.709	298.4	28.00	. . 12.0	12
.711	300.4	27.74	. .	12
1890.556	299.5	28.26	. . 12.0	36
.564	299.2	28.07	. . 12.5	36
.573	299.6	28.22	. .	36

These measures give:

1888.71	299°.7	27".60	3 n
1890.56	299.4	28.18	3 n

β 257.

R. A. $0^h\ 33^m\ 45^s$
Decl. $+\ 46°\ 36'$

1891.657	239°.1	0".66	8.0 . . . 8.7	36
.692	236.3	0.63	8.0 . . . 9.0	36
.709	236.0	0.65	8.3 . . . 8.6	36
1891.68	237.1	0.65	8.1 . . . 8.8	36

α Cassiopeiae.

R. A. $0^h\ 33^m\ 42^s$
Decl. $+\ 55°\ 53'$

A and B.

1889.594	273°.1	17".61	. . 14.5	36
.608	271.6	17.55	. .	36
.611	272.5	17.51	. . 14.5	36
1889.60	272.4	17.56	. . 14.5	

A and C.

1889.594	105°.7	39".65	. . 14.0	36
.608	105.5	39.40	. .	36
.611	106.2	40.12	. . 14.0	36
1889.60	106.5	39.72	. . 14.0	

A and D (=H_2 1993).

1889.594	280°.0	63".27	. . . 9.0	36
.608	280.1	62.96	. . . 9.0	36
.611	280.4	63.36	. . . 9.0	36
1889.60	280.2	63.20	. . . 9.0	

The nearest star, *B*, has not been seen before. The second companion, *C*, was added with the Chicago 18½-inch. My previous measures of this and the HERSCHEL star are as follows:

1878.11	108°.7	40".07	β	2 n	AC
.11	279.9	62.38	β	2 n	AD

β 865.

R. A. $0^h\ 37^m\ 14^s$
Decl. $+\ 42°\ 35'$

1891.815	197°.2	1".21	8.5 . . . 9.0	12
.838	198.8	1.40	8.3 . . . 8.5	12
.845	196.2	1.30	8.2 . . . 8.8	36
1891.83	197.4	1.30	8.3 . . . 8.8	

β 231. o Cassiopeiae.

R. A. $0^h\ 38^m\ 2^s$
Decl. $+\ 47°\ 38'$

1888.706	303°.6	32".89	. . 11.5	12
.709	303.1	32.50	. . 11.5	12
.711	303.9	32.50	. . 11.8	12
1888.71	303.5	32.63	. . 11.6	

The only earlier measure is:

1876.51	303°.9	32".81	De	1 n

β 866.

R. A. $0^h\ 38^m\ 5^s$
Decl. $+\ 42°\ 35'$

1891.815	72°.6	1".43	9.3 . . . 9.3	12
.838	67.7	1.38	9.0 . . . 9.1	12
.845	68.5	1.37	8.7 . . . 8.8	36
1891.83	69.6	1.39	9.0 . . . 9.1	

β 493.

R. A. $0^h\ 39^m\ 4^s$
Decl. $+\ 50°\ 27'$

1891.845	50°.3	0".77	9.0 . . . 9.1	36
.862	52.5	0.77	9.0 . . . 9.1	36
1891.85	51.4	0.77	9.0 . . . 9.1	

β 492. B.A.C. 201.

R. A. $0^h\ 38^m\ 28^s$
Decl. $+\ 54°\ 34'$

1889.547	150°.9	2".09	5.5 . . 11.5	36
.553	153.1	2.08	5.8 . . 11.5	36
.556	154.2	2.16	5.7 . . 11.0	36
1889.55	152.7	2.11	5.7 . . 11.3	

The only earlier measure is the following:

1878.73	152°.6	1".90	β	2 n

β 495.

R. A. $0^h\ 42^m\ 25^s$
Decl. $+18°\ 2'$

1891.655	224°.4	0".64	7.6 . . . 7.8	36
.657	225.1	0.67	7.5 . . . 7.7	36
.660	225.2	0.63	7.5 . . . 7.6	36
1891.66	224.9	0.65	7.5 . . . 7.7	

β 301.

R. A. $0^h\ 43^m\ 21^s$
Decl. $-22°\ 3'$

A and B.

1891.785	319°.5	0".94	. . 14.0	36
.791	320.2	0.81	. . 14.0	36
.810	316.7	0.94	. . 14.0	36
1891.79	318.8	0.90	. . 14.0	

A and C.

1891.763	301°.5	11".34	8.7 . . . 9.4	12
.785	300.5	11.22	8.3 . . . 9.3	36
.791	300.1	11.14	8.0 . . . 9.5	36
1891.78	300.7	11.23	8.3 . . . 9.4	

In measuring the wide pair with the 36-inch, the close star was added. It is very difficult.

β 232.

R. A. $0^h\ 43^m\ 38^s$
Decl. $+49°\ 59'$

A and B.

1891.657	321°.3	0".36	8.3 . . . 8.4	36
.660	319.7	0.33	8.0 . . . 8.1	36
.673	319.4	0.53	7.6 . . . 7.8	36
1891.66	320.1	0.41	8.0 . . . 8.1	

AB and C.

1891.657	293°.9	28".47	. . . 9.3	36
.660	294.1	28.49	. . . 9.0	36
.673	293.5	28.23	. . . 9.0	36
1891.66	293.8	28.40	. . . 9.1	

The close pair appears to be in rapid motion:

1876.23	288°.4	0".48	Δ	6 n	

β 781.

R. A. $0^h\ 44^m\ 0^s$
Decl. $+68°\ 20'$

1891.581	31°.4	0".86	8.0 . . . 8.3	36
.594	28.1	0.92	8.0 . . . 8.3	36
.597	30.5	0.85	8.2 . . . 8.5	36
1891.59	30.0	0.88	8.1 . . . 8.4	

β 496.

R. A. $0^h\ 45^m\ 17^s$
Decl. $+12°\ 8'$

1891.636	4°.3	5".31	7.4 . . 12.5	36
.638	4.1	5.31	7.6 . . 12.5	36
1891.64	4.2	5.31	7.5 . . 12.5	

β 1.

R. A. $0^h\ 45^m\ 45^s$
Decl. $+55°\ 58'$

A and B.

1889.540	80°.9	1".62	8.0 . . 10.0	36
.556	82.8	1.54	8.2 . . 9.5	36
.570	84.1	1.20	8.5 . . 10.0	36
1889.55	82.6	1.45	8.2 . . 9.8	

A and C.

1889.540	134°.9	3".87	. . . 8.7	36
.556	134.3	3.82	. . . 8.6	36
.570	133.5	3.77	. . . 8.7	36
1889.55	134.2	3.82	. . . 8.7	

A and D.

1889.540	193°.2	9".04	. . . 8.7	36
.570	194.2	8.90	. . . 8.8	36
1889.55	193.7	8.97	. . . 8.7	

A and E.

1889.540	332°.8	15".83	. . 13.0	36
.556	333.1	15.82	. . 12.0	36
.570	333.4	15.88	. . 12.5	36
1889.55	333.1	15.84	. . 12.5	

For comparison we have:

1875.34	81°.0	1".42	Δ	4 n	AB
.34	133.3	3.70	Δ	4 n	AC
.34	192.9	8.82	Δ	4 n	AD

β 497. B.A.C. 239.

R. A. $0^h\ 45^m\ 55^s$
Decl. $+\ 60°\ 28'$

A and B.

1891.499	171.2	123.66	6.0 . .	36
.504	171.1	123.87	6.0 . .	36
.537	171.4	124.15	6.0 . .	36
1891.51	171.2	123.89	6.0 . .	

B and C.

1891.504	148.7	0.81	9.0 . . 11.5	36
.537	151.0	0.71	9.0 . . 11.5	36
1891.52	149.8	0.76	9.0 . . 11.5	

β 498.

R. A. $0^h\ 46^m\ 33^s$
Decl. $+\ 9°\ 9'$

1891.958	157.4	2.74	8.0 . . 11.3	36
.969	151.8	2.65	8.0 . . 12.0	36
1891.96	154.6	2.70	8.0 . . 12.6	

β 734. Ceti 132.

R. A. $0^h\ 46^m\ 47^s$
Decl. $-\ 24°\ 39'$

1888.838	347.4	10.66	7.0 . . 10.0	12
.851	346.4	11.01	. .	12
1888.84	346.9	10.83	7.0 . . 10.0	

Apparently unchanged:

1879.68	348.9	10.74	β	3 n

OΣ 20. 66 Piscium.

R. A. $0^h\ 48^m\ 15^s$
Decl. $+\ 18°\ 32'$

1891.655	340.9	0.42	. . .	36
.650	339.9	0.36	5.5 . . . 6.0	36
.673	342.2	0.39	6.5 . . . 6.8	36
1891.66	341.0	0.39	6.0 . . . 6.4	

β 1028. γ Cassiopeiae.

R. A. $0^h\ 48^m\ 50^s$
Decl. $+\ 60°\ 1'$

1889.512	255.1	2.05	. . 11.5	36
.526	256.5	2.22	. . 11.5	36
.534	254.2	2.25	. . 11.5	36
.553	255.8	2.09	. . 12.0	36
1889.53	255.4	2.15	. . 11.6	

The measures of last year gave:

1888.69	255.9	2.18	β	6 n

β 233.

R. A. $0^h\ 49^m\ 9^s$
Decl. $-\ 18°\ 6'$

1891.958	90.5	1.14	8.0 . . . 9.0	36

β 1099. B.A.C. 255.

R. A. $0^h\ 49^m\ 33^s$
Decl. $+\ 59°\ 43'$

1891.657	280.0	0.10	6.5 . . . 6.5	36
.692	284.9	0.14	6.0 . . . 6.0	36
.733	281.8	0.13	6.0 . . . 6.0	36
1891.69	282.2	0.12	6.2 . . . 6.2	

A fine close pair discovered with this telescope in 1889.

OΣ 21.

R. A. $0^h\ 56^m\ 4^s$
Decl. $+\ 46°\ 44'$

1891.499	34.9	1.04	7.7 . . . 8.2	36
.537	37.4	0.92	8.0 . . . 8.4	36
.575	33.7	0.99	8.0 . . . 8.7	36
1891.54	35.3	0.98	7.9 . . . 8.4	

β 396. B.A.C. 282.

R. A. $0^h\ 56^m\ 13^s$
Decl. $+\ 60°\ 26'$

1888.681	66.5	1.22	6.5 . . 10.0	12
.720	66.4	1.14	6.3 . . 9.0	12
.733	66.8	1.22	6.3 . . 8.5	12
.758	67.4	1.37	6.0 . . 9.5	12
1889.534	67.3	1.18	6.0 . . 10.0	36
.537	65.7	1.40	6.0 . . 9.8	36
.553	66.1	1.27	6.0 . . 10.0	36

The mean results are:

1888.72	66.8	1.25	4 n
1889.53	66.4	1.28	3 n

No evidence of change:

1877.05	66.4	1.24	Δ	4 n

β 735.

R. A. $0^h\ 58^m\ 55^s$
Decl. $-34^\circ\ 10'$

1891.815	220.0	8.62	6.0 . . 10.5	12
.835	219.2	8.34	6.0 . . 10.5	12
.838	221.8	9.09	. .	12
1891.83	220.3	8.68	6.0 . . 10.5	

β 501.

R. A. $1^h\ 0^m\ 40^s$
Decl. $-5^\circ\ 17'$

1891.925	32.3	2.70	8.0 . . 11.5	36
.928	31.2	2.73	8.0 . . 11.5	36
.958	30.5	2.75	8.3 . . 11.5	36
1891.94	31.3	2.73	8.1 . . 11.5	

β 397.

R. A. $1^h\ 0^m\ 53^s$
Decl. $+46^\circ\ 12'$

1891.689	142.1	8.66	7.4 . . 9.0	36
.695	141.9	8.77	7.0 . . 10.8	36
.709	141.6	8.67	7.5 . . 9.0	36
1891.70	141.9	8.70	7.3 . . 9.6	

β 502.

R. A. $1^h\ 2^m\ 13^s$
Decl. $+15^\circ\ 9'$

1891.958	305.5	3.16	8.2 . . 11.0	36
1892.036	305.8	3.32	8.3 . . 11.5	36
1892.00	305.6	3.24	8.2 . . 11.2	

OΣ 515. φ Andromedae.

R. A. $1^h\ 2^m\ 32^s$
Decl. $+46^\circ\ 36'$

1890.575	249.6	0.30	5.0 . . . 6.0	36
.594	247.8	0.30	. . .	36
.610	255.0	0.36	. . .	36
1890.59	250.8	0.32	. . .	

Excessively difficult in the following, as the star is low, and measure not very certain:

1892.386	118.2	0.13	36

H 2021.

R. A. $1^h\ 3^m\ 4^s$
Decl. $-19^\circ\ 16'$

1891.763 Nothing seen. Good definition. All the stars examined.

HERSCHEL thought this star was a close double. I have looked for it before without success. There is certainly no close pair in or near this place.

β 303. Piscium 201.

R. A. $1^h\ 3^m\ 9^s$
Decl. $+23^\circ\ 9'$

1891.958	285.8	0.64	7.0 . . . 7.0	36
.969	283.9	0.79	7.5 . . . 7.5	36
1891.96	284.8	0.71	7.2 . . . 7.2	

β 868.

R. A. $1^h\ 2^m\ 54^s$
Decl. $+51^\circ\ 24'$

1891.689	233.9	9.21	8.0 . . . 9.3	36
.709	233.6	9.30	7.8 . . . 9.3	36
1891.70	233.7	9.25	7.9 . . . 9.3	36

β 235.

R. A. $1^h\ 3^m\ 27^s$
Decl. $+50^\circ\ 22'$

A and B.

1889.523	85.7	0.76	7.5 . . . 7.6	12
.534	85.9	0.79	7.0 . . . 7.0	36
.553	86.6	0.82	7.0 . . . 7.3	36
1891.657	85.7	0.68	7.0 . . . 7.2	36
.692	87.4	0.69	7.3 . . . 7.5	36
.709	84.9	0.75	7.5 . . . 7.6	36

The mean results are:

1889.53	86.1	0.79	3 n
1891.68	86.0	0.71	3 n

This star, with distant companions, is OΣ 24. There appears to be some change in the close pair:

1875.65	74.0	0.48	Δ	6 n
1883.75	78.5	0.59	En	6 n

β 2.

R. A. $1^h\ 3^m\ 47^s$
Decl. $+29^\circ\ 14'$

1891.971	155.9	2.25	8.7 . . . 9.0	36

Ho. 215. 45 Andromedae.

R. A. $1^h\ 4^m\ 26^s$
Decl. $+\ 37^\circ\ 5'$

1890.630	Not double.	36
.660	Absolutely round with powers to 1500, and fine conditions. Cannot be double.	36
.675	Perfectly round. Seeing magnificent.	36

HOUGH gave the angle 259°.1 (1889.97) 1 n. There is probably some mistake about this star, as it would be a very easy pair with this telescope, according to his description.

β 398.

R. A. $1^h\ 4^m\ 52^s$
Decl. $+\ 47^\circ\ 10'$

1891.499	49°.4	1".80	8.8 . . . 8.9	36
.537	51.3	1.88	9.0 . . . 9.0	36
1891.51	50.3	1.84	8.9 . . . 9.0	

β 258.

R. A. $1^h\ 5^m\ 29^s$
Decl. $+\ 61^\circ\ 4'$

1889.537	266°.5	1".00	6.5 . . 10.0	36
.578	268.0	1.01	6.5 . . 9.0	36
.589	270.0	0.97	6.0 . . 10.0	36
1889.57	268.2	0.99	6.3 . . 9.7	

This may have slow motion in angle and distance:

1875.20	260°.4	0".79	Δ	4 n
1881.63	264.4	0.89	β	3 n

*O*Σ 27 rej. 35 Ceti.

R. A. $1^h\ 6^m\ 26^s$
Decl. $+\ 1^\circ\ 50'$

1891.475	Perfectly round with highest powers. Fine definition.
.731	Single, with all powers. Seeing good enough for 0".15.

β 1029. ζ Piscium.

R. A. $1^h\ 7^m\ 27^s$
Decl. $+\ 6^\circ\ 56'$

B and C.

1890.903	249°.4	0".75	. . 13.5	36
.911	248.6	1.02	. . 13.5	36
.939	248.5	0.77	. . 13.5	36
1890.92	248.8	0.85	. . 13.5	

A and B. (Σ 100).

1890.911	63°.2	23".76	36
.939	63.9	23.65	36
1890.92	63.5	23.70	

There does not seem to be any change in the small star since my measures in 1888.

Polaris.

R. A. $1^h\ 14^m\ 46^s$
Decl. $+\ 88^\circ\ 40'$

1889.293.	Carefully examined with the 36-inch with various powers. Both stars single, and no companion nearer than the Σ star.

A and C.

1890.785	83°.0	44".70	. . 14.5	36
.802	83.7	44.67	. . 15.5	36
1890.79	83.3	44.68	. . 15.0	

A and D.

1890.785	169°.2	82".80	. . 14.0	36
.802	170.7	82.86	. . 14.0	36
1890.79	170.0	82.83	. . 14.0	

In 1884 I examined *Polaris* with the Chicago refractor, and measured the places of the nearest stars I could see with that instrument. The measures, which have never been published, are as follows:

1884.74	88°.0	43".28	. . 13.0	1 n
.74	172.2	82.68	. . 12.0	1 n

These are small stars with the 36-inch. There is nothing nearer than the Σ companion.

β 4. Piscium 255.

R. A. 1h 14m 59s
Decl. + 10° 55′

1890.851	69°.6	0″.41	8.0 . . . 9.0	36
.879	69.7	0.40	7.5 . . . 8.5	36
.882	67.2	0.42	7.5 . . . 8.5	36
.903	70.2	0.38	8.0 . . . 9.0	36
1890.88	69.2	0.40	7.8 . . . 8.8	

Some of the measures made heretofore are very discordant, and would appear to indicate rapid motion; but it is now quite certain that the change is rather slow. Both angle and distance seem to be diminishing.

β 1101. Ψ Cassiopeiae.

R. A. 1h 17m 27s
Decl. + 67° 30′

A and B.

1891.499	47°.7	2″.92	. . 13.0	36
.504	43.5	3.00	. . 13.0	36
.537	41.9	3.00	. . 12.5	36
.562	46.5	2.79	. . 11.5	36
1891.52	44.9	2.93	. . 12.5	

β 505. θ Ceti.

R. A. 1h 18m 2s
Decl. — 8° 48′

1891.925	59°.8	60″.50	. . 13.5	36
.928	59.7	59.94	. . 14.0	36
.958	59.5	59.92	. . 13.5	36
1891.94	59.7	60.12	. . 13.7	

β 999 (ω Andromedae).

R. A. 1h 20m 27s
Decl. + 44° 47′

A and B.

1888.681	95°.2	2″.29	. . 12.0	12
.706	94.7	2.73	. . 11.5	12
.711	96.3	2.90	. .	12
1888.70	95.4	2.64	. . . 11.8	
1891.969	100.9	2.25	5.0 . . 11.0	36
.971	99.3	2.52	5.0 . . 12.5	36
1892.085	100.5	2.07	6.0 . . 11.0	36
1892.01	100.2	2.28	5.3 . . 11.5	

A and C.

1888.706	110°.4	132″.62		12
.709	110.5	132.55		12
.851	109.9	132.30		12
1888.75	110.3	132.49		
1889.971	110.3	130.93		36

C and D.

1888.706	136°.5	5″.06	10.5 . . 10.5	12
.709	138.7	4.91	10.0 . . 10.0	12
.851	137.5	4.91	. . 12.0	
1888.75	137.9	4.96	10.2 . . 10.2	
1891.971	137.9	4.60	11.0 . . 11.0	36
1892.085	140.1	4.47	10.0 . . 10.1	36
1892.03	139.0	4.53	10.5 . . 10.5	

There is a faint star between the pairs.

The change in AC is due to the proper motion of A. This is common to AB.

β 506. η Piscium.

R. A. 1h 25m 4s
Decl. + 14° 44′

1888.695	14°.7	1″.25	. . 11.0	36
.720	16.2	1.03	. . 10.0	12
.785	18.6	1.02	. . 9.0	12
1890.725	13.0	0.95	. . 11.5	36
.777	16.0	1.02	. . 10.5	36
.840	14.1	1.01	. . 11.0	36

These observations give:

1888.73	16°.5	1″.10	. . 10.0	3 n
1890.78	14.8	0.99	. . 11.0	3 n

β 507.

R. A. 1h 29m 16s
Decl. + 26° 10′

1891.969	152°.9	1″.80	8.0 . . 11.5	36
.971	150.9	2.24	8.0 . . 11.0	36
1892.039	149.9	2.00	8.0 . . 10.5	36
1891.99	151.2	2.01	8.0 . . 11.0	

β 1000.

R. A. 1h 29m 27s
Decl. — 30° 32′

A and B.

1891.838	361°.5	1″.58	8.0 . . 13.0	12
.845	352.8	1.29	8.0 . . 12.5	36
.854	354.8	1.46	8.0 . . 13.5	36
1891.84	356.4	1.44	8.0 . . 13.0	

A and C.

1891.840	20°.2	142″.58	7.8 . . . 8.0	12
.854	20.7	141.52	. . . 8.5	36
.856	20.6	142.16	8.0 . . . 8.5	12
1891.85	20.5	142.09	7.9 . . . 8.3	

The angle of AB has increased 20° since 1881.

H 2061.

R. A. 1h 30m 2s
Decl. — 18° 8′

1890.936	322°.7	63″.13	7.5 . . 9.5	36
.939	322.2	62.98	7.5 . . 10.0	36
1890.94	322.4	63.05	7.5 . . 9.7	

This star has a large proper motion, 0″.414 in the direction of 116°.5. There are no other measures of the companion with which to compare these. HERSCHEL gave the angle 326°.7, and estimated distance 30″. Evidently there would be but little change in the angle.

β 869.

R. A. 1h 30m 3s
Decl. + 3° 42′

1891.958	198°.1	5″.02	8.3 . . 11.0	36
1892.017	198.4	5.33	8.0 . . 11.5	36
.039	197.3	5.49	8.0 . . 11.0	36
1892.00	197.9	5.31	8.1 . . 11.2	

β 870. B.A.C. 525.

R. A. 1h 36m 22s
Decl. + 56° 56′

1891.594	58°.5	1″.17	6.5 . . 8.0	36
.597	59.9	0.99	6.7 . . 8.7	36
.600	60.8	1.18	6.7 . . 10.0	36
1891.60	59.7	1.11	6.6 . . 8.9	

β 453.

R. A. 1h 37m 8s
Decl. + 56° 31′

1891.594	239°.0	0″.84	8.5 . . . 8.6	36
.597	228.2	0.93	8.5 . . . 8.6	36
.600	228.4	0.82	8.3 . . . 8.3	36
1891.60	228.5	0.86	8.4 . . . 8.5	

β 509.

R. A. 1h 37m 25s
Decl. + 8° 58′

1891.731	259°.4	0″.68	8.3 . . . 8.7	36
.733	258.5	0.74	8.5 . . . 8.6	36
.753	259.7	0.69	8.5 . . . 8.7	36
1891.74	259.2	0.70	8.4 . . . 8.7	

In my first measures of this pair, there is probably an error of 180° in the angle; but there is considerable change. The quadrant is certainly correct in the later measures. The observations at the time of discovery were:

1878.42	93°.5	0″.71	β	3 n

β 736.

R. A. 1h 39m 38s
Decl. + 38° 20′

A and B.

1890.898	209°.4	0″.75	8.5 . . 11.0	36
.900	208.3	0.80	8.5 . . 11.0	36
.911	210.2	0.75	8.5 . . 11.0	36
1890.90	209.3	0.77	8.5 . . 11.0	

A and C (Σ 157).

1890.898	116°.6	12″.63	. . . 8.6	36
.900	115.6	12.59	. . . 8.7	36
.911	115.5	12.46	. . . 8.7	36
1890.90	115.9	12.56	. . . 8.7	

β 510.

R. A. 1h 42m 4s
Decl. + 15° 44′

A and B.

1891.903	334°.5	1″.61	8.0 . . 10.0	36
.909	335.3	1.66	8.0 . . 10.0	36
.953	336.2	1.35	8.3 . . 11.5	36
1891.92	335.3	1.54	8.1 . . 10.5	

A and C (=*H V.* 92).

1891.903	327°.2	53".57	... 8.0	36
.909	326.8	53.19	... 8.0	36
.953	327.6	53.28	... 8.5	12
1891.92	327.2	53.35	... 8.2	

β 511.

R. A. 1h 42m 40s
Decl. — 2° 1′

B and C.

1891.903	314°.1	3".97	8.4 . . 11.5	36
.909	318.8	3.82	8.1 . . 11.8	36
.958	319.4	3.95	8.2 . . 11.5	36
1891.92	317.4	3.91	8.2 . . 11.6	

A and B (=Σ 171).

1891.903	159°.8	30".22	... 8.4	36
.909	160.1	30.25	... 8.0	36
.958	159.9	30.22	... 8.2	36
1891.92	159.9	30.23	... 8.2	

β 1016.

R. A. 1h 42m 52s
Decl. + 32° 29′

1890.898	27°.1	0".59	8.5 . . . 8.5	36
.900	28.0	0.56	8.5 . . . 8.5	36
.911	28.4	0.63	8.5 . . . 8.5	36
1890.90	27.8	0.59	8.5 . . . 8.5	

There are no other measures of this pair.

Ho —.

R. A. 1h 44m 32s
Decl. + 24° 4′

1890.903	179°.3	0".36	8.0 . . . 8.2	36
.911	176.9	0.39	7.0 . . . 7.1	36
.939	176.3	0.35	7.5 . . . 7.7	36
1890.92	177.5	0.37	7.5 . . . 7.7	

Discovered by HOUGH. From GOULD'S Journal, No. 215.

β 512.

R. A. 1h 47m 12s
Decl. + 18° 42′

1890.564	25°.8	1".60	8.0 . . 12.5	36
.573	24.0	1.69	8.7 . . 11.0	36
.610	21.5	1.64	9.0 . . 11.5	36
1890.58	23.8	1.64	8.6 . . 11.7	

This star is the distant companion to *γ Arietis*, measured by Sh. The only other measures of this pair are:

1878.01	27°.3	1".45	β	2 n

Σ 186.

R. A. 1h 49m 41s
Decl. + 1° 15′

1890.879	229°.4	0".33	7.5 . . . 7.5	36
.882	225.8	0.32	6.5 . . . 6.5	36
.890	226.1	0.28	. . .	36
1891.731	231.0	0.28	. . .	36
.733	232.7	0.27	. . .	36
.766	235.0	0.28	. . .	36
.785	232.1	0.25	. . .	36

The means are:

1890.88	227°.1	0".31	3 n
1891.75	232.7	0.27	4 n

The angular motion has been about 160° since 1831. Some of the measures are very discordant. The period cannot be less than one hundred and twenty years. (*Sidereal Messenger*, February, 1891).

β 513. 48 Cassiopeiae.

R. A. 1h 52m 7s
Decl + 70° 19′

1888.681	295°.2	0".72	5.0 . . 6.0	12
.698	299.2	0.72	4½ . . 6.0	12
.706	294.9	0.76	5.0 . . 6½	12
.720	303.1	1.10	5.0 . . 6½	12
1889.512	302.6	0.72	5.0 . . 10.0	36
.515	305.3	0.66	5.0 . . 8.0	36
.537	305.3	0.91	. .	36
1890.594	309.1	0.60	5.0 . . 7.5	36
.610	309.9	0.48	. .	36
.633	306.6	0.58	. .	36
.652	308.7	0.56	. .	36
1891.597	314.2	0.51	5.0 . . 7.0	36
.600	312.8	0.58	5.0 . . 7.5	36
.633	314.6	0.58	. .	36
.626	312.5	0.65	5.0 . . 8.5	36

The following are the mean results:

1888.70	298°.1	0".83	4 n
1889.52	304.4	0.76	3 n
1890.62	308.6	0.55	4 n
1891.61	313.5	0.58	4 n

This will soon be a very difficult object. The change will be principally in distance, and in a few years it will probably be out of the reach of the large telescope. The measures down to this time indicate a period of a little less than forty years.

There is a faint distant companion:

A and C.

1891.600	51°.4	23".64	. . 13.5	36
.633	51.3	23.80	. . 13.5	36
.626	50.9	23.56	. . 13.7	36
1891.62	51.2	23.67		

β 514.

R. A. $1^h\ 53^m\ 57^s$
Decl. $-\ 13°\ 54'$

1891.903	134°.4	6".46	8.0 . . 10.0	36
.909	134.1	6.09	8.0 . . 9.5	36
.958	134.0	6.53	8.4 . . 10.5	36
1891.92	134.2	6.36	8.1 . . 10.0	

There is an error of 30° in the angle as given in β (X). It should read 135°.3.

β 785. 49 Cassiopeiae.

R. A. $1^h\ 54^m\ 4^s$
Decl. $+\ 75°\ 32'$

1889.512	245°.3	5".40	5.3 . . 12.5	36
.515	245.7	5.30	5.0 . . 13.5	36
.537	241.0	5.50	5.0 . . 13.5	36
1889.52	243.7	5.40	5.1 . . 13.2	

The only other measures are:

1881.70	245°.7	5".22	β	4 n

β 872.

R. A. $1^h\ 54^m\ 28^s$
Decl. $+\ 32°\ 44'$

1891.969	185°.5	4".86	8.4 . . 11.8	36
.971	185.5	5.04	8.3 . . 11.8	36
1891.97	185.5	4.95	8.3 . . 11.8	

β 515.

R. A. $1^h\ 54^m\ 38^s$
Decl. $+\ 15°\ 59'$

1891.958	243°.2	1".24	8.0 . . 11.0	36
1892.017	246.5	1.39	8.0 . . 11.0	36
.036	243.6	1.30	8.3 . . 12.0	36
1892.00	244.4	1.31	8.1 . . 11.3	

β 873.

R. A. $1^h\ 56^m\ 6^s$
Decl. $+\ 63°\ 49'$

1891.499	23°.1	2".11	6.8 . . 10.7	36
.504	27.4	1.98	7.3 . . 11.0	36
.537	31.0	2.28	7.0 . . 11.0	36
1891.51	27.2	2.12	7.0 . . 10.9	

OΣ 38. γ Andromedae.

R. A. $1^h\ 56^m\ 32^s$
Decl. $+\ 41°\ 45'$

B and C.

1888.600	Only a slight elongation in the direction of 120° with 2700 on the 36-inch.	
1889.515	98°.2	0".09 36
1890.526	Elongation doubtful with 1900. Distance much less than 0".1.	
.573	Seems to be slightly elongated in 304°.6. Distance decidedly less than 0".1.	
.594	Elongation, if any, too uncertain to measure with the highest power.	
.660	Tried with all powers, and the elongation, if any, is so slight that a measure would have no value. Seeing magnificent, and the star nearly in the zenith.	
1891.575	310°.7	Slight elongation with 2600.
.785	308.0	Distance not more than 0".05.
.810	319.0	Excessively close.
1891.72	312.6	

All the foregoing observations were made with the 36-inch. The distance should be increasing.

β 874. 5 Persei.

R. A. $2^h\ 3^m\ 18^s$
Decl. $+\ 57^\circ\ 5'$

1891.499	274°.2	5".55	6.0 . . 13.5	36
.504	274.1	4.98	6.0 . . 13.0	36
.537	273.9	5.66	6.0 . . 13.0	36
1891.51	274.1	5.40	6.0 . . 13.2	

Without change.

Hastings.

R. A. $2^h\ 10^m\ 3^s$
Decl. $-\ 18^\circ\ 47'$

1890.939	342°.3	2".26	8.0 . . . 8.2	36
.955	341.6	2.27	8.0 . . . 8.3	36
.974	340.3	2.11	8.0 . . . 8.4	36
1890.95	341.4	2.21	8.0 . . . 8.3	

The change in this pair is clearly the result of proper motion, but this does not correspond to the proper motion derived from the meridian observations, which is about 0".24 in the direction of 186°. Considering A as fixed, the apparent motion of B is about 0".1 annually in the direction of 54°. These stars are probably similar to the components of 61 *Cygni*, and have each a different proper motion.

β 437.

R. A. $2^h\ 12^m\ 26^s$
Decl. $+\ 3^\circ\ 39'$

1891.953	35°.5	6".81	8.0 . . 11.5	12
.958	32.3	7.37	8.0 . . 11.5	36
.969	32.5	7.39	8.0 . . 11.0	36
1891.96	33.4	7.19	8.0 . . 11.3	

Mira Ceti.

R. A. $2^h\ 13^m\ 17^s$
Decl. $-\ 3^\circ\ 31'$

1890.709	87°.9	73".70	. . 12.5	36
.840	88.4	74.18	. . 13.0	36
1890.77	88.1	73.94	. . 12.7	

I found this faint star at Chicago. It is between the variable and HERSCHEL'S companion. The only other measures are:

1878.88	90°.0	74".70	β	2 n

β 875. 9 Persei.

R. A. $2^h\ 13^m\ 59^s$
Decl. $+\ 55^\circ\ 19'$

1891.499	161°.4	11".84	5.8 . . 13.5	36
.504	161.4	11.61	5.5 . . 13.5	36
.537	160.2	11.47	6.0 . . 13.5	36
1891.51	161.0	11.64	5.8 . . 13.5	

H 3498.

R. A. $2^h\ 16^m\ 43^s$
Decl. $-\ 28^\circ\ 25'$

1890.840	No companion of any kind seen. Good seeing.	36

H gave the magnitudes 7 and 16, and the distance 10"±, with the note, "Triple? Excessively difficult." The principal star is *Lac.* 711.

β 876.

R. A. $2^h\ 16^m\ 46^s$
Decl. $+\ 32^\circ\ 58'$

A and B.

1891.859	228°.3	1".06	7.8 . . 12.0	36
.884	233.9	1.02	7.6 . . 11.8	36
1891.87	231.1	1.04	7.7 . . 11.9	

C and D (= Σ 258).

1891.859	27°.9	6".13	8.8 . . . 9.0	36
.884	28.4	6.05	9.0 . . . 9.4	36
1891.87	28.1	6.09	8.9 . . . 9.2	

A and C (= Σ 258).

1891.859	146°.2	69".92		36
.862	146.2	70.21		36
1891.87	146.2	70.06		

No change in the STRUVE stars.

β 738.

R. A. $2^h\ 18^m\ 5^s$
Decl. $-\ 30^\circ\ 25'$

1891.766	172°.7	0".57	6.8 . . . 7.3	36
.785	176.8	0.47	7.3 . . . 7.5	36
.845	173.4	0.60	7.5 . . . 7.5	36
1891.80	174.3	0.55	7.1 . . . 7.4	

β 739.

R. A. $2^h\ 19^m\ 33^s$
Decl. $-30°\ 24'$

1891.763	263°.7	1".23	8.2 . . . 8.5	12
.766	267.2	1.50	8.0 . . . 8.4	36
.785	267.0	1.62	8.2 . . . 8.4	36
1891.77	266.0	1.45	8.1 . . . 8.4	

Distance seems to be less.

β 518. Ceti 389.

R. A. $2^h\ 23^m\ 11^s$
Decl. $+9°\ 2'$

1891.731	137°.1	1".76	6.4 . . 11.0	36
.753	139.0	1.50	6.5 . . 11.5	36
.766	139.9	1.85	6.3 . . 11.5	36
1891.75	138.7	1.70	6.4 . . 11.0	

β 519.

R. A. $2^h\ 23^m\ 38^s$
Decl. $-2°\ 48'$

1891.859	59°.4	0".70	8.3 . . . 9.0	36
.862	59.5	0.68	8.3 . . . 8.8	36
1891.86	59.4	0.69	8.3 . . . 8.9	

Change in angle is probable.

β 304.

R. A. $2^h\ 24^m\ 5^s$
Decl. $+36°\ 56'$

1891.969	283°.6	19".60	8.0 . . 11.0	36
.971	282.9	18.64	7.0 . . 11.0	36
1892.039	281.9	19.02	8.0 . . 11.5	36
1891.99	282.8	19.09	7.7 . . 11.2	

Σ 279.

R. A. $2^h\ 28^m\ 15^s$
Decl. $+36°\ 47'$

1888.706	70°.3	18".00	6.5 . . 11.0	12
.709	70.4	17.47	7.3 . . 10.5	12
1888.71	70.3	17.73	6.9 . . 10.7	

β 305. Persei 58.

R. A. $2^h\ 30^m\ 52^s$
Decl. $+37°\ 13'$

1888.706	205°.2	20".76	6.5 . . 10.8	12
.709	205.9	20.79	7.5 . . 10.5	12
1888.71	205.5	20.77	7.0 . . 10.7	

No change.

β 521.

R. A. $2^h\ 34^m\ 59^s$
Decl. $+47°\ 45'$

1891.969	154°.1	5".59	6.4 . . 11.5	36
.971	155.0	5.66	6.5 . . 11.5	36
1891.97	154.5	5.62	6.5 . . 11.5	

β 522. μ Arietis.

R. A. $2^h\ 35^m\ 36^s$
Decl. $+19°\ 30'$

1891.958	262°.5	19".17	6.0 . . 13.5	36
.971	264.3	19.67	6.0 . . 13.5	36
1892.036	262.6	18.91	6.0 . . 13.0	36
1892.00	263.1	19.25	6.0 . . 13.3	

Without change.

β 83.

R. A. $2^h\ 39^m\ 59^s$
Decl. $-5°\ 28'$

1891.766	114°.4	0".85	7.5 . . . 9.0	36
.769	110.3	0.96	8.3 . . . 8.7	36
.772	110.4	0.90	8.0 . . . 9.5	36
1891.77	111.7	0.90	7.9 . . . 9.1	

Considerable change in angle and distance.

β 740.

R. A. $2^h\ 40^m\ 29^s$
Decl. $+29°\ 11'$

1890.652	Large star, certainly not double.	36
.840	Not double. Both stars round.	36

As a wide pair this is β 307. Subsequently I examined it with the 6-inch, and thought the large star was a very close double. This is probably not the case.

β 262.

R. A. $2^h\ 40^m\ 33^s$
Decl. $+30°\ 33'$

1891.731	60°.2	1".65	8.4 . . 9.0	36
.733	62.5	1.75	8.3 . . 10.5	36
.755	63.2	1.46	7.8 . . 9.5	12
.769	60.7	1.72	8.0 . . 9.3	36
1891.75	61.6	1.64	8.2 . . 9.6	

β 877. γ Fornacis.

R. A. $2^h\ 44^m\ 33^s$
Decl. $-25^\circ\ 3'$

A and B.

1891.958	146°.7	12".11	6.0 . . 12.0	36
.969	144.4	11.95	6.0 . . 13.5	36
1891.96	145.5	12.03	6.0 . . 12.7	

A and C (= *H* 2161).

1891.958	155°.6	47".73	. . 10.5	36
.969	155.7	46.76	. . 10.5	36
1891.96	155.6	47.24	. . 10.5	

H 3535.

R. A. $2^h\ 44^m\ 42^s$
Decl. $-28^\circ\ 26'$

1890.832	Not double.	36

This star, B. A. C. 883, HERSCHEL thought was a close pair. I have never been able to see it, nor has any one else, so far as I know, except that it was noted as elongated by WILSON at Cincinnati. I do not think it can be really double.

β 524. 20 Persei.

R. A. $2^h\ 46^m\ 9^s$
Decl. $+37^\circ\ 51'$

A and B.

1889.594	291°.3	0".17	5.5 . . . 6.0	36
1890.594	287.5	0.17	5.0 . . . 6.0	36
.610	288.0	0.20	5.0 . . . 6.0	36
.630	287.2	0.17	. . .	36
1891.785	285.2	0.13	6.0 . . . 7.0	36
.791	279.9	0.17	5.5 . . . 6.5	36
.810	279.9	0.15	6.0 . . . 7.5	36

AB and C (= Σ 318).

1890.594	237°.5	14".07	. . . 9.0	36
.610	237.1	14.06	. . . 9.5	36
.630	237.1	14.10	. . .	36
1890.61	237.2	14.08	. . . 9.2	

The close pair is in rapid motion. The change in angle is about 50° since 1878. The distance is steadily decreasing. The following are all the measures:

1878.66	338°.7	0".34	β	3 n
1880.82	323.1	0.29	β	4 n
1881.67	334.9	0.28	β	1 n
1889.59	291.3	0.17	β	1 n
1890.61	287.6	0.18	β	3 n
1891.79	281.7	0.15	β	3 n

β 741.

R. A. $2^h\ 51^m\ 58^s$
Decl. $-25^\circ\ 27'$

A and B.

1891.766	166°.1	1".27	8.0 . . . 8.2	36
.769	165.2	1.20	7.8 . . . 8.0	36
.785	165.4	1.32	7.7 . . . 7.8	36
1891.77	165.6	1.26	7.8 . . . 8.0	

A and C (= *S* 423).

1891.766	221°.0	27".91	. . . 8.0	36
.769	220.9	28.22	. . . 7.8	36
.785	221.5	27.98	. . . 7.8	36
1891.77	221.1	28.04	. . . 7.9	

β 525. B.A.C. 920.

R. A. $2^h\ 52^m\ 0^s$
Decl. $+21^\circ\ 8'$

1890.851	123°.2	0".36	6.7 . . . 6.8	36
.867	120.1	0.31	7.5 . . . 7.5	36
.879	303.2	0.32	7.5 . . . 7.6	36
1891.731	123.2	0.25	7.5 . . . 7.5	36
.733	122.4	0.30	7.5 . . . 7.5	36
.766	118.3	0.32	7.5 . . . 7.5	36

These measures give:

1890.87	122°.2	0".33	3 n
1891.74	121.3	0.29	3 n

The distance is diminishing and the angle increasing.

Algol.

R. A. $3^h\ 0^m\ 21^s$
Decl. $+40^\circ\ 30'$

1890.660	At first a suspicion of a slight elongation with 2600 in a nearly north and south direction, but too vague to place any reliance on. First-class night. $0^h\ 15^m$ S. T.	36

1890.687	Star appears symmetrical under all powers. $23^h\ 50^m$ S. T.	36

None of the stars, which have been supposed from spectroscopic observations to be close doubles, have shown any evidence of the fact when examined with the large telescope under the most favorable conditions. It is possible that some other explanation will be found for the recurrent phenomenon first discovered by Miss MAURY in the Harvard spectrum photographs. At all events, it is hardly worth while, until the method has been verified upon some of the numerous known pairs suitable for this purpose, to consume the valuable time of the great telescope in a further examination of objects of this class.

The following are measures of the several companions which make β 526:

A and B.

1891.969	156.8	57.89	.. 13.0	36
.971	154.0	57.08	.. 14.0	36
1891.97	155.4	57.48	.. 13.5	

A and C.

1891.971	144.3	68.38	.. 14.2	36

A and D.

1891.969	192.5	81.13	.. 11.0	36
.971	192.5	81.89	.. 11.0	36
1891.97	192.5	81.51	.. 11.0	

D and E.

1891.969	116.5	11.49	.. 12.0	36
.971	113.6	11.56	.. 13.0	36
1891.97	115.0	11.52	.. 12.5	

B and C.

1891.969	101.9	14.83	..	36

β 527.

R. A. $3^h\ 0^m\ 35^s$
Decl. $-\ 13^\circ\ 43'$

1891.958	66.9	0.81	8.3 . . . 8.5	36
1892.039	65.6	0.82	8.0 . . . 8.3	36
.088	65.5	0.85	8.0 . . . 8.5	36
1892.03	66.0	0.83	8.1 . . . 8.4	

β 400. Eridani 103.

R. A. $3^h\ 5^m\ 18^s$
Decl. $-\ 4^\circ\ 16'$

1891.958	53.9	22.59	6.5 . . 12.5	36
.969	54.3	22.89	7.6 . . 11.0	36
1891.96	54.1	22.74	7.0 . . 11.7	

β 529.

R. A. $3^h\ 8^m\ 9^s$
Decl. $-\ 9^\circ\ 1'$

1891.859	223.2	3.19	8.0 . . 12.5	36
.862	221.7	3.03	8.1 . . 12.0	36
1891.86	222.4	3.11	8.0 . . 12.2	

β 530. Arietis 161.

R. A. $3^h\ 8^m\ 18^s$
Decl. $+\ 22^\circ\ 30'$

B and C.

1891.958	193.8	1.48	9.5 . . 10.0	36
1892.017	195.2	1.94	10.0 . . 10.3	36
.036	193.5	1.67	9.5 . . 10.0	36
1892.00	194.2	1.70	9.7 . . 10.1	

A and B (= Σ 366 rej.).

1891.958	40.9	48.45	7.6 . . .	36
1892.036	40.9	48.36	8.0 . . .	36
1892.00	40.9	48.40	7.8 . . .	

β 84.

R. A. $3^h\ 10^m\ 5^s$
Decl. $-\ 6^\circ\ 22'$

1890.882	28.0	0.72	6.7 . . . 7.2	36
.890	30.2	0.66	6.5 . . . 6.6	36
.893	24.7	0.75	7.0 . . . 7.5	36
.906	26.2	0.78	7.0 . . . 8.0	36
1890.89	27.3	0.73	6.8 . . . 7.3	

This pair is much easier now than it was when I found it with the 6-inch in 1872. It is not certain that there has been much change in the angle.

1875.85	10.3	0.44	Δ	5 n
1879.39	32.4	0.72	β	5 n

A. C. 2. 95 Ceti.

R. A. $3^h\ 12^m\ 12^s$
Decl. $-\ 1°\ 22'$

1888.720	104.4	0.53	6.0 . . . 8.0	12
.818	121.2	0.37	6.0 . . . 9.0	36
1888.77	112.8	0.45	6.0 . . . 8.5	

1890.882 Nothing seen of the companion. Good seeing.
.867 Tried all powers with favorable conditions, but the small star could not be seen.
1891.731 Single, with powers from 350 to 1900. Splendid seeing. These examinations of the star were with the 36-inch.

This is the most mysterious and strange double star in the heavens. I have tried it, first and last, perhaps hundreds of times with apertures all the way from 6 to 36 inches without being able to see any trace of the little star. At the time of its discovery by ALVAN CLARK with a 7½-inch refractor, the distance was 0″.7, and the angle was measured by DAWES in 1854. In 1888 I got two measures of it with this telescope, but it was very difficult, the distance being 0″.45. If the small star is not variable, and it is not at all probable that it is, it must be in very rapid motion. I hope to watch it carefully hereafter. A new pair was found in a low-power field with this star, which is given in the accompanying list of new stars (β 1177).

β 742.

R. A. $3^h\ 17^m\ 0^s$
Decl. $+\ 48°\ 50'$

1891.657 No double found here.
.731 No double star in or near this place. Good seeing.

This star was suspected, in 1879 with the 6-inch, to be a close pair. This was probably a mistake, as the large telescope fails to show anything.

β 531.

R. A. $3^h\ 17^m\ 26^s$
Decl. $-\ 8°\ 13'$

1891.731	53.0	3.01	6.3 . . 11.5	36
.753	53.0	2.87	6.5 . . 12.0	36
.766	54.9	2.93	6.7 . . 11.5	36
1891.75	53.6	2.94	6.5 . . 11.7	

This star (L 6275) has a proper motion of 0″.250 in 180°.0, and this is common to both stars. Very little relative change since 1875.

β 878. 66 Arietis.

R. A. $3^h\ 21^m\ 26^s$
Decl. $+\ 22°\ 23'$

1890.882	79.7	1.40	6.0 . . 13.5	36
.890	72.9	1.25	6.0 . . 13.5	36
.898	75.8	1.23	5.5 . . 14.0	36
1890.89	76.1	1.29	5.8 . . 13.7	

The only other measures are:

1881.06	78.0	1.10	β	2 n

Σ 412. 7 Tauri.

R. A. $3^h\ 27^m\ 20^s$
Decl. $+\ 24°\ 4'$

A and B.

1889.589	36.9	0.31	6.0 . . . 6.0	36
.594	37.4	0.29	6.3 . . . 6.3	36
.687	34.7	0.32	6.0 . . . 6.0	36
.689	36.7	0.29	6.0 . . . 6.0	36
1889.64	36.4	0.30	6.0 . . . 6.0	

AB and C.

1889.589	59.7	22.15	. . . 9.0	36
.594	59.9	22.20	. . . 9.5	36
.687	59.6	22.04	. . . 9.5	36
1889.62	59.7	22.13	. . . 9.3	

β 532.

R. A. $3^h\ 27^m\ 25^s$
Decl. $-\ 10°\ 27'$

1891.859	271.8	3.02	8.0 . . 11.0	36
.862	270.7	3.08	8.3 . . 12.5	36
1891.86	271.2	3.05	8.1 . . 11.7	

β 533. B. A. C. 1101.

R. A. $3^h\ 28^m\ 9^s$
Decl. $+\ 31°\ 17'$

1891.657	55.3	0.52	7.5 . . . 7.5	36
.709	50.4	0.50	8.2 . . . 8.2	36
.711	230.9	0.52	8.3 . . . 8.4	36
1891.69	52.2	0.51	8.0 . . . 8.0	

The angle is decreasing.

β 534.

R. A. $3^h\ 33^m\ 1^s$
Decl. $-\ 8^\circ\ 54'$

1891.859	193°.7	2".57	8.0 . . 11.5	36
.862	192.6	2.60	8.0 . . 12.0	36
1891.86	193.1	2.58	8.0 . . 11.7	

β 535. 38 Persei.

R. A. $3^h\ 36^m\ 47^s$
Decl. $+\ 31^\circ\ 54'$

1888.678	55°.3	0".99	. . .	36
.681	61.9	1.19	. . . 9.0	12
.785	60.5	1.10	. . . 8.5	12
1888.71	59.2	1.09		

The following are all the earlier measures:

1877.84	60°.5	0".96	Δ	1 n
1878.25	56.8	0.93	β	4 n

β 880.

R. A. $3^h\ 37^m\ 3^s$
Decl. $+\ 31^\circ\ 47'$

A and B.

1891.657	354°.0	0".42	8.3 . . . 8.3	36
.709	355.2	0.51	8.5 . . . 8.5	36
.711	354.9	0.59	8.5 . . . 8.5	36
1891.69	354.7	0.51	8.4 . . . 8.4	

AB and C (= Σ 439).

1891.657	38°.2	23".30	. . . 9.0	
.709	38.6	23.50	. . . 9.2	
.711	38.0	23.47	. . . 9.5	
1891.69	38.3	23.42	. . . 9.2	

Barnard. D. M. (23°) 502.

R. A. $3^h\ 37^m\ 8^s$
Decl. $+\ 23^\circ\ 43'$

1891.903	146°.3	1".52	10.0 . . 10.3	36
.969	147.7	1.47	9.2 . . 9.3	36
1892.036	147.8	1.56	9.7 . . 9.8	36
1891.97	147.3	1.52	9.6 . . 9.8	

Discovered by BARNARD with the 12-inch in 1891. It is 37^s preceding, and 47" south of, *Electra*. There is another pair in the field of nearly the same magnitudes, but the distance is 6" or 8".

β 536.

R. A. $3^h\ 39^m\ 8^s$
Decl. $+\ 23^\circ\ 49'$

A and B.

1890.689	317°.7	0".22	8.0 . . . 8.5	36
.867	325.1	0.14	8.0 . . . 8.5	36
.879	324.3	0.21	8.0 . . . 8.5	36
1891.709	323.5	0.15	8.5 . . . 8.7	36
.731	317.3	0.15	8.5 . . . 9.0	36
.785	310.6	0.26	8.5 . . . 9.0	36

The mean results are:

1890.81	322°.4	0".19	8.0 . . . 8.5
1891.74	317.1	0.19	8.5 . . . 8.9

AB and C (= *S* 437).

1891.709	303°.1	36".95	. . . 8.5	36
.731	303.1	36.96	. . . 8.4	36
.785	303.1	36.85	. . . 8.3	36
1891.74	303.1	36.92	. . . 8.4	

C and D.

1891.709	9°.6	18".17	. . 13.0	36
.731	9.0	18.40	. . 13.5	36
.785	9.6	18.47	. . 13.0	36
1891.74	9.4	18.35	. . 13.0	

This is one of the stars in the Pleiades, and is the principal star of the wide pair, *S* 437. It is $1^m\ 13^s$ preceding *Alcyone*, and 4' 52" north. The change has been principally in distance, and it is now a difficult pair. The only other measure is:

1878.69	336°.4	0".44	β	3 n

β 537.

R. A. $3^h\ 39^m\ 53^s$
Decl. $+\ 24^\circ\ 28'$

1890.879	185°.8	0".45	8.5 . . 10.5	36
.882	186.0	0.44	8.2 . . 9.5	36
.890	182.5	0.55	8.5 . . 9.5	36
1890.88	184.8	0.48	8.4 . . 9.8	

This is also in the Pleiades. Probably unchanged.

1877.91	185°.9	0".60	β	3 n

β 1003.

R. A. 3h 40m 23s
Decl. — 28° 15′

1891.958	31°.8	2″.30	8.3 . . 11.0	36
1892.036	29.9	2.68	8.3 . . 12.0	36
.039	29.6	2.46	8.0 . . 11.0	36
1892.01	30.4	2.48	8.2 . . 11.3	

β 539.

R. A. 3h 43m 12s
Decl. — 1° 53′

1891.859	270°.8	2″.65	8.2 . . 10.5	36
.862	272.5	2.73	8.5 . . 10.7	36
1891.86	271.6	2.69	8.3 . . 10.6	

No change.

β 401.

R. A. 3h 44m 10s
Decl. — 1° 52′

1891.859	256°.9	4″.65	6.4 . . 10.8	36
.862	255.2	4.63	7.0 . . 11.5	36
1891.86	256.0	4.64	6.7 . . 11.1	

Without change.

β 743.

R. A. 3h 46m 36s
Decl. + 51° 54′

1891.769	248°.1	0″.76	8.2 . . . 9.0	36
.772	245.2	0.77	8.2 . . . 9.0	36
.785	245.0	0.70	8.3 . . . 9.0	36
1891.77	246.1	0.74	8.2 . . . 9.0	

H 338. 30 Eridani.

R. A. 3h 46m 47s
Decl. — 5° 43′

1890.867	Large star, certainly single.	36

⊿ thought the large star elongated in 165°. I always found it round with the 6-inch, and it is surely single now.

β 540.

R. A. 3h 48m 21s
Decl. + 31° 48′

A and B.

1891.657	324°.2	1″.33	8.5 . . 12.0	36
.709	325.6	1.20	8.4 . . 11.5	36
.711	324.2	1.32	8.5 . . 12.0	36
1891.69	324.7	1.28	8.5 . . 11.8	

A and C.

1891.657	57°.3	57″.02	. . . 8.5	36
.709	57.2	57.06	. . . 8.4	36
.711	57.3	57.25	. . . 8.5	36
1891.69	57.3	57.11	. . . 8.5	

β 85.

R. A. 3h 48m 34s
Decl. + 17° 17′

1891.804	219°.5	4″.09	8.0 . . 10.0	36
.810	215.7	3.92	8.0 . . 10.3	36
.824	216.3	3.98	8.5 . . 10.5	36
1891.81	217.2	4.00	8.2 . . 10.3	

β 542.

R. A. 3h 50m 21s
Decl. — 7° 18′

1891.958	196°.3	1″.41	8.5 . . . 9.5	36
.969	189.3	1.41	8.4 . . . 8.7	36
1892.036	193.0	1.73	8.3 . . . 8.6	36
1892.01	192.9	1.52	8.4 . . . 8.9	

β 543.

R. A. 3h 51m 24s
Decl. — 1° 30′

1891.731	29°.0	11″.19	8.0 . . 10.8	36
.753	28.8	11.28	8.0 . . 11.0	36
.766	27.4	11.11	8.0 . . 10.5	36
1891.75	28.4	11.19	8.0 . . 10.8	

This star is said to have a proper motion of 0″.283 in the direction of 228°.3. If this is correct, the two stars have some relation, notwithstanding their distance, because they have remained substantially unchanged since my first measures in 1877.

Σ 481.

R. A. 3h 54m 52s
Decl. + 27° 47′

A and B.

1891.882	102°.5	2″.61	8.3 . . 11.5	36
.887	104,5	2.21	8.0 . . 10.5	36
.903	103.2	2.63	8.9 . . 10.8	36
1891.89	103.4	2.48	8.1 . . 10.9	

A and C.

1891.882	326°.1	17".17	.. 10.0	36
.887	328.2	17.24	.. 9.3	36
.903	327.1	17.27	.. 10.0	36
1891.89	327.1	17.23	.. 9.8	

β 544. 36 Tauri.

R. A. 3h 57m 11s
Decl. + 23° 47′

1892.036	256°.9	25".63	5.0 .. 12.5	36
.039	256.6	26.06	6.0 .. 13.5	36
.055	256.2	26.60	5.5 .. 13.5	36
1892.04	256.6	26.10	5.5 .. 13.2	

β 1005.

R. A. 3h 59m 20s
Decl. + 28° 37′

1891.884	60°.7	2".80	8.5 .. 12.5	36
.887	61.8	2.12	8.2 .. 12.0	36
.893	62.6	2.50	8.5 .. 11.5	36
1891.89	61.7	2.47	8.4 .. 12.0	

β 545.

R. A. 3h 59m 24s
Decl. + 37° 42′

1890.775	310°.6	1".17	8.0 .. 10.5	36
.785	311.5	1.05	8.0 .. 10.0	36
.802	309.6	1.18	8.0 .. 11.0	36
.824	308.8	0.97	8.0 .. 10.8	36
1890.79	310.1	1.09	8.0 .. 10.6	
1891.769	306.2	1.14	8.3 .. 12.0	36
.785	312.5	0.94	8.2 .. 12.0	36
.791	309.1	1.06	8.3 .. 9.0	36
1891.78	309.3	1.05	8.3 .. 11.0	

No material change since 1878.

β 545 and OΣ 531.

1890.775	208°.1	235".60	...	36
.785	208.2	235.43	...	36
1890.78	208.1	235.51	...	

β 545 is the star used for measuring the parallax of OΣ 531, the latter having the same proper motion as 50 *Persei*. OΣ suspected the latter to have a very minute companion. The 36-inch failed to show any near attendant. There is probably no change in the pair above measured.

1878.24	310°.0	1".02	β	4 n

OΣ 531.

R. A. 3h 59m 34s
Decl. + 37° 46′

1891.772	135°.0	2".27	7.3 .. 9.0	36
.785	134.1	2.37	8.0 .. 10.0	36
.791	133.9	2.10	8.0 .. 10.0	36
1891.78	134.3	2.25	7.8 .. 9.7	

Hough.

R. A. 4h 1m 44s
Decl. + 28° 20′

1891.903	169°.2	0".35	8.5 ... 8.5	36
1892.017	167.6	0.25	8.5 ... 8.5	36
.036	170.7	0.36	8.5 ... 8.6	36
1891.98	169.2	0.32	8.5 ... 8.5	

The only other measures are:

1890.13	346°.5	0".29	Ho.	2 n

β 1232, which is 30′ north, is a similar but more difficult pair.

β 547. 47 Tauri.

R. A. 4h 7m 25s
Decl. + 8° 58′

1888.775	363°.2	0".98	...	12
.821	359.0	0.90	5.0 ... 8.0	12
.832	357.0	0.85	5.5 ... 8.5	12
1888.81	359.7	0.91		

There seems to be no change since 1877.

Σ 518. 40 Eridani.

R. A. 4h 9m 52s
Decl. — 7° 47′

B and C.

1888.832	107°.5	3".26	...	12
.851	106.7	2.96	...	12
.859	106.3	2.59	...	12
1888.84	106.8	2.94	...	

1890.681	99°.5	2".73	...	36
.709	99.0	2.80	...	36
.760	100.9	2.43	...	36
.775	100.4	2.75	...	36
1890.73	100.0	2.68	...	
1891.766	97.1	2.40	...	36
.772	96.4	2.45	...	36
.785	99.2	2.64	...	36
.810	96.8	2.45	...	36
1891.78	97.4	2.48	...	

A and B.

1888.838	105°.6	82".28	...	12
.851	105.4	82.03	...	12
1888.84	105.5	82.15	...	

β 548.

R. A. 4h 10m 53s
Decl. — 10° 23′

1891.859	345°.1	6".20	7.0 . . 11.5	36
.862	345.8	6.00	7.3 . . 11.0	36
1891.86	345.4	6.10	7.1 . . 11.2	

Σ 520.

R. A. 4h 11m 6s
Decl. + 22° 31′

1891.845	110°.3	0".91	8.3 . . . 8.4	36
.854	111.3	0.95	8.5 . . . 8.6	36
.859	110.6	0.89	8.3 . . . 8.4	36
1891.85	110.7	0.92	8.4 . . . 8.5	

OΣ 79. 55 Tauri.

R. A. 4h 13m 2s
Decl. + 16° 14′

1890.660	85°.7	0".35	7.0 . . . 8.0	36
.673	89.8	0.48	6.0 . . . 7.5	36
.675	89.6	0.36	6.0 . . . 7.5	36
.681	86.6	0.35	6.5 . . . 7.5	36
1890.67	87.9	0.38	6.4 . . . 7.6	

Certainly a binary, but the period will be rather long. The angular movement has been 63° since 1846.

β 310.

R. A. 4h 14m 21s
Decl. + 39° 39′

1891.884	171°.5	19".36	8.0 . . 11.0	36
.887	171.0	18.70	7.0 . . 10.5	36
.903	172.5	19.26	8.0 . . 12.0	36
1891.89	171.7	19.11	7.7 . . 11.2	

U Tauri.

R. A. 4h 14m 49s
Decl. + 19° 32′

1891.772	203°.6	3".25	9.3 . . . 9.4	36
.804	204.1	3.03	9.0 . . . 9.2	36
.810	203.7	3.08	9.0 . . . 9.1	36
1891.79	203.8	3.12	9.1 . . . 9.2	

This star is supposed to be variable. The only other measures of it as a double star are by KNOTT, 202°.1 : 3".10 (1868.01) 2 n.

β 87.

R. A. 4h 15m 19s
Decl. + 20° 32′

1891.804	167°.9	2".01	6.5 . . 10.0	36
.810	168.9	1.99	6.7 . . 11.0	36
.826	171.3	1.92	6.5 . . 10.5	36
1891.81	169.4	1.97	6.6 . . 10.5	

OΣ 82.

R. A. 4h 15m 55s
Decl. + 14° 46′

1891.969	149°.4	0".56	8.0 . . . 8.7	36
1892.036	149.2	0.69	8.0 . . . 8.7	36
1892.00	149.3	0.62	8.0 . . . 8.7	

Σ 537.

R. A. 4h 16m 21s
Decl. — 10° 14′

1891.862	340°.4	15".98	7.5 . . 10.5	36

β 744. Eridani 299.

R. A. 4h 16m 32s
Decl. — 26° 0′

A and B.

1891.766	124°.0	0".74	7.7 . . . 7.7	36
.772	125.8	0.88	7.6 . . . 7.6	36
.810	310.0	0.74	7.5 . . . 7.7	36
1891.78	306.6	0.79	7.6 . . . 7.6	

AB and C (= *H* 3644).

1891.772	6.4	35.56	. . 11.5	36
.810	7.2	35.28	. . 12.0	
1891.79	6.8	35.42	. . 11.7	

AB and D (= *H* 3644).

1891.776	40.4	44.66	. . . 8.5	36
.772	40.7	44.60	. . . 8.3	36
.810	40.2	44.63	. . . 8.0	
1891.78	40.4	44.63	. . . 8.3	

No other measures of the close pair. HERSCHEL measured only the angles of the distant companions.

β 402.

R. A. 4h 17m 3s
Decl. — 1° 33′

1891.859	73.2	7.55	8.3 . . 11.0	36
.862	72.8	7.42	8.4 . . 11.5	36
1891.86	73.0	7.48	8.3 . . 11.2	

β 745.

R. A. 4h 19m 10s
Decl. + 53° 49′

1891.859	134.3	0.51	8.3 . . . 8.3	36
.862	134.0	0.54	8.3 . . . 8.3	36
1891.86	134.1	0.52	8.3 . . . 8.3	

No other measures of this pair.

71 Tauri.

R. A. 4h 19m 30s
Decl. + 15° 21′

1890.681 Certainly not double. 36

This star was suspected to be a close pair by the observers at Cambridge. I have examined it a good many times with various instruments, but never saw anything suspicious. I do not think it is worth while following this up any longer.

Σ 547.

R. A. 4h 19m 48s
Decl. — 1° 40′

1890.802	28.9	2.07	8.5 . . 9.5	36
.824	28.3	1.92	8.3 . . 9.5	36
.832	28.3	2.05	8.7 . . 10.0	36
1890.82	28.5	2.01	8.5 . . 9.7	

The change in this pair is due to proper motion. (See *Observatory*, January, 1891.) The apparent annual movement of the small star is 0″.052 in the direction of 137°.8.

Σ 554. 80 Tauri.

R. A. 4h 23m 17s
Decl. + 15° 23′

1890.879 Single with all powers.
1891.731 No certain elongation with any power. Fine seeing.

It was examined on several other nights with the same result.

β 549.

R. A. 4h 23m 2s
Decl. — 12° 13′

1891.859	189.7	8.55	7.8 . . 11.0	36
.862	191.4	8.77	. .	36
1891.86	190.5	8.66	7.8 . . 11.0	

Probably unchanged.

β 550. Aldebaran.

R. A. 4h 29m 2s
Decl. + 16° 16′

A and B.

1890.856	108.5	31.40	. . 14.0	36
.862	109.9	31.37	. . 14.0	36
.890	108.6	31.24	. . 14.5	36
1890.87	109.0	31.34	. . 14.2	

C and D (*β* 1031).

1890.851	278.9	1.78	11.0 . . 13.0	36
.862	277.5	2.08	. .	36
.867	281.3	1.94	11.0 . . 13.5	36
.882	278.6	1.57	11.0 . . 14.0	36
1890.86	279.1	1.84	11.0 . . 13.5	
1891.657	277.4	1.79	10.0 . . 13.5	36
.731	276.2	1.86	10.8 . . 13.5	36
.785	277.5	1.84	11.0 . . 14.0	36
1891.72	277.0	1.83	10.6 . . 13.7	

A and C (Σ 2, App. II).

1890.854	34.4	117.36	. .	12
.856	34.1	117.19	. .	12
.862	34.6	116.98	. .	36
.867	34.3	116.55	. .	36
1890.86	34.3	117.02	. .	

The Companions of Aldebaran.

(From *Monthly Notices*, March, 1891.)

I have recently finished a set of measures of the companions of *Aldebaran* with the large telescope, and these, taken in connection with prior measures, are of considerable interest in showing the relations existing between the bright star and its several attendants. The nearest companion was found with the Chicago 18½-inch refractor in 1877, and this is now shown to have the same proper motion as the principal star; a result which would not be expected, considering the distance and great difference in magnitudes. Both distance and position-angle appear to have remained unchanged, the small difference in measures being fully accounted for by the extreme minuteness of the companion, and the difficulty of measuring it so near a first magnitude star. It was a very difficult object to see with the Chicago telescope, and might easily be overlooked even with the 36-inch refractor. I give below all the measures that have been made of this star.

The more distant Herschel companion has been observed for more than a hundred years, and the change shown by the measures has usually been ascribed solely to the proper motion of *Aldebaran*. The distinguished French astronomer, Flammarion, was the first to notice the fact that the well-known proper motion of *A* could not account for the relative change, and therefore he came to the conclusion that *B* must have a proper motion of its own, and in a different direction. Of the correctness of this view there can be no doubt, and the amount and direction of the relative displacement of *C* should be as well known as of most stars. This motion is almost exactly half that of *A*, and is perhaps larger than that of any known star as faint as the eleventh magnitude, which is not connected and moving with some brighter component.

In looking at this object, in 1888, with the 36-inch, I found that the Herschel companion was also double, or had a very faint attendant a little more than 2″ distant. This is too difficult for most telescopes, and I am not aware that it has been seen elsewhere. It was measured in 1888, and again this year.

The several positions of *B* and *C*, as shown by the measures, are given accurately to scale on the diagram. The annual proper motion of *A* is taken as 0″.188 in the direction of 164°.4. The central position of *A* is for the date of Struve's measure of *C* (1836); and the later measures are laid off from the actual place of *A* along the line of its movement, as determined by the proper motion already given. In the same manner the positions of *B* are laid down, the first and last measures in each case being connected with *A* by the lines shown in the diagram.

The following are the measures used:

A and B (*β* 550).

1877.89	109°.0	30″.45	*β*	3 n
1878.00	110.5	31.26	Hl	3 n
1880.11	111.2	31.46	*β*	2 n
1888.82	109.5	30.90	*β*	2 n
1890.87	109.0	31.34	*β*	3 n

A and C (*H* VI. 66).

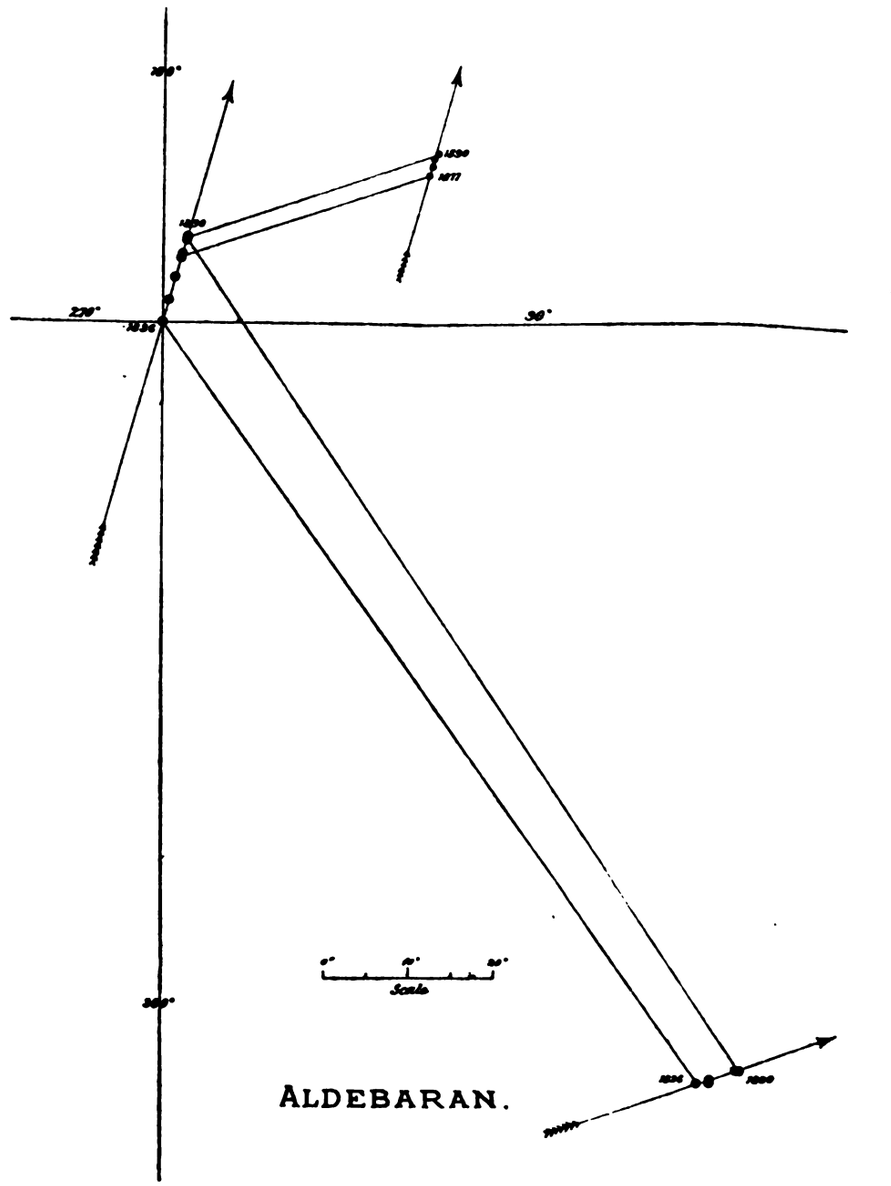
1836.06	36°.0	109″.04	Σ	2 n
1851.40	35.5	111.60	*O*Σ	
1864.24	34.8	112.79	De	6 n
1887.00	34.5	116.27	Hl	20 n
1889.98	34.6	116.97	*β*	7 n

C and D (*β* 1031).

1888.81	281°.1	2″.34	*β*	3 n
1890.86	279.1	1.84	*β*	4 n
1891.72	277.0	1.83	*β*	3 n

It is apparent from the measures of *B* that its proper motion is substantially, and probably exactly, the same as that of *A*. The mean of the five sets of measures of this companion for the angle is 109°.8, and for the distance 31″.08. The differences between these values and the separate measures are really very small when the extreme faintness of the companion is taken into account.

From the measures of *C* we find that this companion has an annual motion of 0″.095 in the direction of about 109°.6. I have not used Herschel's measure of 1781, making the angle 36°.0, and the distance 87″.75. At best this would be only approximate. By the assumed motion of the stars, the angle at this time should have been 38°, and the distance 102″. Evidently at one time these stars were much nearer together; and by carrying the motions back it is shown that the minimum distance of 40″ occurred about A. D. 1130. At this time the distance of *BC* was less than 11″; and about the middle of that century it was a little less than 9″.



The measures of *CD* do not cover a sufficient time to tell with certainty what the relation of *D* is to this group. As the angle *CD* is nearly in the line of the motion of *C*, the distance between these stars should be about 0".2 more in 1890 than in 1888, if *D* does not share the motion of *C;* but from the measures this distance is 0".5 less at the former date. This would appear to indicate that the proper motion was common to both stars, and that there was a relative change due to some other cause. Measures made two or three years hence will at once settle this question.

The HERSCHEL companion is the star generally used for the determination of the differential parallax of *Aldebaran;* but as the proper motion of the small star does not appear to have been taken into account, the result obtained would seem to be materially affected by an error from this source.

β 881. 46 Eridani.

R. A. $4^h\ 29^m\ 4^s$
Decl. $-\ 7^\circ\ 0'$

1891.766	51.7	1.23	6.0	10.5	36
.772	54.4	1.43	6.0	10.5	36
.785	52.0	1.21	6.0	11.5	36
1891.77	52.7	1.29	6.0	10.8	

The angle is slowly diminishing.

Σ 566. 2 Camelopardali.

R. A. $4^h\ 30^m\ 27^s$
Decl. $+\ 53^\circ\ 14'$

A and B.

1888.922	292.4	1.62	...	36
.925	291.8	1.57	...	36
.928	291.4	1.54	...	36
1888.92	291.9	1.58		

A and C.

1888.922	210.6	23.47	13.0	36
.925	209.6	24.17	13.0	36
.928	209.3	23.43	13.5	36
1888.92	209.8	23.66	13.2	

A star near this, 3 *Camelopardali*, was found to be a new pair, and this pair was measured after observing the other. The faint star, *C*, has not been seen heretofore. The slow retrograde motion of the close pair continues.

β 88. 51 Eridani.

R. A. $4^h\ 31^m\ 32^s$
Decl. $-\ 2^\circ\ 43'$

1891.882	90.2	32.51	6.0	13.0	36
.887	90.0	32.26	5.5	11.5	36
1891.88	90.1	32.38	5.7	12.2	

No other measures.

β 882.

R. A. $4^h\ 32^m\ 14^s$
Decl. $-\ 11^\circ\ 23'$

1891.887	225.8	2.20	8.8	9.5	36
.903	227.6	2.44	8.7	9.3	36
.958	225.7	2.11	8.5	9.5	36
1891.91	226.4	2.25	8.7	9.4	

54 Eridani.

R. A. $4^h\ 35^m\ 12^s$
Decl. $-\ 19^\circ\ 54'$

1891.766	Certainly single. Fine definition.	36

This star was thought to be a close pair by the Cincinnati observers. I have never been able to see anything of it.

β 551. 96 Tauri.

R. A. $4^h\ 42^m\ 52^s$
Decl. $+\ 15^\circ\ 42'$

B and C.

1891.903	204.2	5.80	11.0	13.0	36
.958	206.7	5.61	11.0	13.0	36
.969	205.6	6.09	11.0	12.5	36
1891.94	205.5	5.83	11.0	12.8	

A and B (= *H* 3261).

1891.903	57.5	29.99	6.0	...	36
.958	56.6	29.60	6.0	...	36
.968	56.8	29.78	6.0	...	36
1891.94	57.0	29.79	6.0	...	

β 883.

R. A. $4^h\ 44^m\ 33^s$
Decl. $+\ 10^\circ\ 52'$

A and B.

1891.14	Single.				36
1891.785	125.2	0.12	7.5	7.8	36
1892.057	116.4	0.06±	...		36
.060	127.8	0.12	...		36
1891.97	123.1	0.12	...		

AB and C.

1891.052	152.2	18.22	6.8	13.0	36

A remarkable binary in rapid motion.

GLASENAPP has recently computed the orbit and finds a period of 16.88 years.

β 552. Orionis 11.

R. A. $4^h\ 45^m\ 3^s$
Decl. $+\ 13^\circ\ 27'$

1890.898	154.3	0.30	6.8	10.0	36
.939	160.2	0.39	6.8	10.5	36
1891.055	155.5	0.30	7.0	10.0	36
1890.96	156.7	0.33	6.9	10.2	

1892.057 No certain elongation with any power. Good seeing.
.060 Round or uncertain with 1500.

This was discovered with the Chicago telescope in 1877. It was not measured, but the distance was estimated 0″.8, and the position-angle 360°, the magnitudes being given as 7 and 10. There has been a wonderful change in the distance, and in 1890 it was one of the most difficult pairs measured with the large telescope. It is certain that it will prove to be a very rapid binary.

β 748.

R. A. $4^h\ 47^m\ 14^s$
Decl. $-\ 7°\ 53'$

1891.840	132°.8	1″.26	8.5	. . . 8.6	12
.862	129.5	1.25	8.7	. . . 8.7	36
1891.85	131.1	1.25	8.6	. . . 8.6	

Δ 5. 7 Camelopardi.

R. A. $4^h\ 47^m\ 41^s$
Decl. $+\ 53°\ 34'$

A and B.

1890.775	297°.9	1″.05		. . 10.5	36
.777	301.5	1.03	5.5	. . 10.0	36
.785	306.8	1.04		. . 10.0	36
1890.77	302.1	1.04		. . 10.2	

Discovered by Δ in 1864. There is little, if any, change.

1865.33	309°.1	1″.24	Δ	8 n

The distant star which makes Σ 610 is relatively fixed.

β 553. o^2 Orionis.

R. A. $4^h\ 49^m\ 53^s$
Decl. $+\ 13°\ 19'$

1891.958	48°.5	29″.88	5.5	. . 12.5	36
.969	47.9	30.30	5.0	. . 13.5	36
1892.036	48.7	29.72	5.0	. . 13.0	36
1892.01	48.4	29.97	5.2	. . 13.0	

β 1045. 99 Tauri.

R. A. $4^h\ 50^m\ 32^s$
Decl. $+\ 23°\ 46'$

1891.810	6°.1	6″.37	6.0	. . 13.0	36
.845	5.3	6.22	6.0	. . 13.5	36
.854	5.4	6.05	6.0	. . 13.5	36
1891.84	5.6	6.21	6.0	. . 13.3	

β 554. ε Aurigae.

R. A. $4^h\ 53^m\ 21^s$
Decl. $+\ 43°\ 39'$

A and B.

1891.859	223°.6	29″.12	. . 13.0	36
.862	226.1	29.49	. . 13.5	36
1891.86	24.8	29.30	. . 13.2	

A and C.

1891.859	275°.3	43″.15	. . 12.0	36
.862	274.7	42.91	. . 11.5	36
1891.86	275.0	43.03	. . 11.7	

A and D.

1891.859	316°.9	46″.23	. . 12.5	36
.862	317.0	46.35	. . 12.8	36
1891.86	317.0	46.29	. . 12.6	

All apparently without change since 1878.

β 314. Leporis 3.

R. A. $4^h\ 53^m\ 39^s$
Decl. $-\ 16°\ 34'$

A and B.

1889.115	327°.5	1″.09	6.0	. . . 8.0	36
.134	324.8	1.06	6.8	. . . 8.5	36
.137	328.3	0.99	6.8	. . . 8.5	36
1889.13	326.9	1.05	6.5	. . . 8.3	

A and C.

1889.115	28°.8	54″.63	. . . 9.0	36
.134	29.2	54.27	. . . 7.5	36
1889.13	29.0	54.45	. . . 8.2	

Change doubtful, but perhaps distance increasing. In three of the measures by Δ the angle is reversed.

1876.69	149°.9	0″.43	Δ	4 n

No other measures of the distant star.

β 315.

R. A. $4^h\ 53^m\ 54^s$
Decl. $+\ 49°\ 22'$

1891.859	226°.2	10″.68	8.7	. . . 9.2	36
.862	225.9	10.66	8.8	. . . 9.7	36
1891.86	226.0	10.67	8.7	. . . 9.4	

Without change.

β 884.

R. A. $4^h\ 57^m\ 22^s$
Decl. $-12°\ 37'$

1891.903	24.9	0.78	8.3 . . . 8.4	36
1892.151	18.1	0.51	8.4 . . . 8.4	36
.153	19.0	0.54	8.5 . . . 8.6	36
1892.04	20.7	0.54	8.4 . . . 8.5	

Unchanged.

β 749.

R. A. $4^h\ 57^m\ 38^s$
Decl. $+55°\ 22'$

1891.859	228.0	1.07	8.2 . . . 8.8	36
.862	229.9	1.16	8.0 . . . 9.0	36
1891.86	228.9	1.11	8.1 . . . 8.9	

OΣ 97.

R. A. $4^h\ 58^m\ 23^s$
Decl. $+22°\ 54'$

1891.115 Certainly single with the 36-inch.

β 751.

R. A. $5^h\ 1^m\ 16^s$
Decl. $+42°\ 31'$

1891.840	260.0	3.13	8.5 . . 10.5	12
.854	255.9	3.02	8.3 . . 9.5	36
1891.85	258.0	3.07	8.4 . . 10.0	

β 1047. Aurigae 47.

R. A. $5^h\ 2^m\ 13^s$
Decl. $+27°\ 53'$

B and C.

1892.057	67.8	0.27	8.5 . . . 8.6	36
.115	67.2	0.30	9.0 . . . 9.1	36
.196	69.8	0.21	8.7 . . . 8.7	36
1892.12	68.3	0.26	8.7 . . . 8.8	

A and BC (= Σ 645).

1892.017	27.0	11.84	7.5 . . .	36
.015	28.0	11.68	6.0 . . .	36
.196	27.2	11.72	6.0 . . .	36
1892.11	27.4	11.75	6.5 . . .	

No change in the wide pair.

β 1006.

R. A. $5^h\ 6^m\ 17^s$
Decl. $-2°\ 21'$

A and B.

1891.903	205.9	0.62	8.6 . . . 9.2	36
.958	201.1	0.71	8.5 . . . 8.9	36
1891.93	203.5	0.66	8.5 . . . 9.9	

AB and C.

1891.903	178.3	52.38	. . . 8.7	36
.958	178.0	52.41	. . . 8.7	36
1891.93	178.2	52.40	. . . 8.7	

β 555. β Orionis.

R. A. $5^h\ 8^m\ 47^s$
Decl. $-8°\ 20'$

B and C.

1889.093 The small star appeared to have no certain elongation with the highest powers on the 36-inch. The fact that this star has appeared to be round for several years with apertures up to 18½ inches, would suggest a possible mistake in the suspected duplicity, although at the time there seemed to be no doubt of the well-known companion being a very close pair. However, it should be carefully watched, since it may be in rapid motion.

1890.775 Small star appears to be single with all powers.

.829 Small star absolutely round with all powers.

.840 Carefully examined with all powers up to the highest. No indication of duplicity.

.890 Fine seeing. *B* is round.

1891.731 Small star, round with all powers. Very fine seeing.

This star has resisted all recent attempts to resolve or elongate it. It may not be double after all, but should be watched for a few years longer.

The foregoing observations were all made with the 36-inch.

β 317.

R. A. $5^h\ 8^m\ 53^s$
Decl. $-23^\circ\ 8'$

1891.845	11.4	8.39	7.0 . .	9.0	36
.884	11.7	8.69	8.0 . .	10.7	36
.887	12.3	8.50	7.3 . .	10.5	36
1891.87	11.8	8.53	7.4 . .	10.1	

β 188. τ Orionis.

R. A. $5^h\ 11^m\ 47^s$
Decl. $-6^\circ\ 58'$

B and C.

1891.903	53.2	3.68	11.0 . .	11.3	36
.958	50.6	3.86	11.0 . .	11.5	36
.969	50.4	3.84	11.0 . .	12.0	36
1891.94	51.4	3.79	11.0 . .	11.6	

A and B (= *H V.* 25).

1891.903	250.1	35.66	. .		36
.958	248.8	34.98	. .		36
.969	248.8	35.17	. .		36
1891.94	249.2	35.27	. .		

A and D (= *H* 2259).

1891.903	60.0	36.05	. .	10.7	36
.958	60.0	36.15	. .	10.7	36
.969	60.1	35.70	. .	10.8	36
1891.94	60.0	35.97	. .	10.7	

β 886.

R. A. $5^h\ 14^m\ 24^s$
Decl. $+33^\circ\ 41'$

C and D.

1892.039	254.2	0.77	8.7 . .	9.0	36
.057	254.1	0.76	9.5 . .	10.5	36
.115	253.1	0.77	9.0 . .	9.3	36
1892.07	253.8	0.77	9.1 . .	9.6	

A and B (= Σ 687).

1892.039	68.2	17.37	8.0 . . .	8.6	36
.088	67.7	17.24	8.2 . . .	8.7	36
1892.06	67.9	17.30	8.1 . . .	8.6	

A and C (= Σ 687).

1892.039	153.9	48.62	. .		36
.088	153.9	48.44	. .		36
1892.06	153.9	48.53	. .		

β 189.

R. A. $5^h\ 14^m\ 32^s$
Decl. $-5^\circ\ 29'$

1891.893	285.6	3.93	6.8 . .	10.5	36
.903	289.3	4.27	7.0 . .	10.0	36
.958	284.6	4.08	6.8 . .	10.0	36
1891.92	286.5	4.09	6.9 . .	10.2	

β 190. Orionis 82.

R. A. $5^h\ 14^m\ 38^s$
Decl. $-8^\circ\ 9'$

A and B.

1890.939	359.9	0.50	8.0 . . .	8.1	36
.955	359.9	0.61	8.0 . . .	8.1	36
1891.055	355.6	0.52	. . .		36
1890.98	358.5	0.54	8.0 . . .	8.1	36

AB and C (= Σ 692).

1890.939	4.2	34.82	. . .	8.7	36
1891.052	3.6	34.97	. . .		36
1890.99	3.9	34.90	. . .		

The close pair was discovered with the 6-inch in 1874. The Σ companion is fixed, and there is not much change in the new pair:

1876.15	355.3	0.71	Δ	4 n

β 887.

R. A. $5^h\ 14^m\ 53^s$
Decl. $+33^\circ\ 18'$

A and B.

1891.903	194.7	0.99	9.0 . .	10.0	36
.906	192.5	0.94	8.7 . .	9.2	36
.909	188.7	0.95	8.8 . .	10.0	36
1891.90	192.0	0.96	8.9 . .	9.7	

A and C.

1891.903	332.1	10.50	. .	12.0	36
.906	331.6	10.55	. .	12.0	36
.909	332.6	10.94	. .	11.5	36
1891.90	332.1	10.66	. .	11.8	

β 888. σ Aurigae.

R. A. $5^h\ 16^m\ 29^s$
Decl. $+\ 37^\circ\ 17'$

1890.936	167°.2	8".64	6.0 . .	13.5	36
.939	168.1	8.69	6.0 . .	13.0	36
1891.033	166.1	8.46		13.0	36
1890.97	167.1	8.60	6.0 . .	13.2	

There would seem to be a change in the distance. The following are the only other measures:

1880.14	171°.0	7".91	β	4 n

β 191.

R. A. $5^h\ 17^m\ 19^s$
Decl. $+\ 34^\circ\ 27'$

1891.840	23°.7	3".58	9.3 . . .	9.3	12
.854	25.4	3.23	9.0 . . .	9.0	36
1891.85	24.5	3.40	9.1 . . .	9.1	

A 13-m star, 144°.4 : 16".7.

β 556.

R. A. $5^h\ 18^m\ 39^s$
Decl. $-\ 2^\circ\ 36'$

1891.791	240°.0	0".90	7.0 . .	11.0	36
.859	238.2	0.90	7.0 . .	12.0	36
.903	239.3	0.87	7.0 . .	11.0	36
1891.85	239.2	0.89	7.0 . .	11.3	

Near *η Orionis*.

β 889.

R. A. $5^h\ 20^m\ 10^s$
Decl. $+\ 34^\circ\ 19'$

A and B.

1891.903	224°.1	0".95	8.7 . . .	9.2	36
.906	219.7	0.79	8.3 . . .	8.7	36
1892.057	227.9	0.65	8.3 . . .	8.6	36
1891.95	223.7	0.80	8.4 . . .	8.8	

A and C.

1891.903	101°.5	3".88		14.5	36
.906	100.3	3.56		14.0	36
1892.057	105.9	3.84		13.8	36
1891.95	102.6	3.76		14.1	

A and D.

1891.903	106°.8	12".06		14.0	36
.906	108.7	11.67		14.0	36
1892.057	108.5	12.44		13.5	36
1891.95	108.0	12.04		13.8	

A and E (= Σ 707).

1891.903	133°.4	18".25		9.3	36
.906	133.3	18.29		9.3	36
1892.057	133.2	18.13		9.5	36
1891.95	133.3	18.22		9.4	

A and D.

1891.903	200°.1	27".91		9.5	36
.906	200.3	27.79		10.8	36
1891.90	200.2	27.85		10.1	

The faint stars *C* and *D* are now seen for the first time.

β 890.

R. A. $5^h\ 20^m\ 49^s$
Decl. $+\ 37^\circ\ 41'$

1891.884	285°.9	1".03	8.5 . . .	8.6	36
.903	284.7	1.13	8.7 . . .	8.8	36
1891.89	285.3	1.08	8.6 . . .	8.7	

No change since 1880.

Σ 711.

R. A. $5^h\ 21^m\ 38^s$
Decl. $+\ 54^\circ\ 35'$

1890.838	Fine seeing; nothing seen of any third star.	36
.840	Both stars round. Certainly not double.	36

In 1865 *Δ* thought the larger star was double.

Σ 719.

R. A. $5^h\ 22^m\ 27^s$
Decl. $+\ 29^\circ\ 27'$

A and B.

1889.096	334°.6	1".03	6.5 . . .	9.0	36

A and C.

1889.096	351°.4	15".16		8.5	36

β 891.

R. A. 5h 22m 48s
Decl. + 18° 19′

A and B.

1891.882	127°.4	10″.35	7.7 . . 13.0	36
1892.022	126.3	10.79	8.2 . . 12.5	36
.036	126.4	10.65	8.0 . . 12.0	36
1891.98	126.7	10.66	8.0 . . 12.5	

A and C (= *H* 3275).

1891.882	20°.9	53″.31	. . . 8.0	36
1892.022	21.2	53.08	. . . 8.2	36
.036	20.8	52.92	. . . 8.1	36
1891.98	21.0	53.10	. . . 8.1	

β 558. δ Orionis.

R. A. 5h 25m 52s
Decl. — 0° 23′

A and B.

1892.039	227°.2	32″.07	. . 14.0	36
.055	227.3	32.37	. . 14.0	36
.088	226.0	32.75	. . 14.0	36
1892.06	226.8	32.40	. . 14.0	

β 557.

R. A. 5h 23m 16s
Decl. + 3° 3′

B and C.

1890.882	148°.5	0″.38	9.0 . . . 9.0	36
.890	145.7	0.35	9.0 . . . 9.0	36
.939	147.8	0.35	9.0 . . . 9.0	36
1890.90	147.3	0.36	9.0 . . . 9.0	

A and BC (= Σ 721).

1890.890	150°.1	24″.55	. . . 7.5	36
.939	149.5	24.68	. . . 7.6	36
1890.91	149.8	24.61	. . .	

There is no change in the Σ pair. The only other measures of the close pair are:

1878.16	142°.4	0″.46	β	2 n
1890.80	153.2	0.3±	Sp	6 n

Σ 728. 32 Orionis.

R. A. 5h 24m 22s
Decl. + 5° 51′

1888.856	175°.8	0″.35	4.0 . . . 6.0	36
1889.110	183.6	0.36	5.0 . . . 6.0	36
.134	178.2	0.44	5.0 . . . 6.0	36
1889.03	179.2	0.38	4.7 . . . 6.0	

This well-known binary has now become a very difficult pair.

β 13.

R. A. 5h 28m 36s
Decl. — 4° 34′

1891.903	130°.8	0″.94	8.3 . . . 8.8	36
1892.039	132.0	1.18	8.3 . . . 9.0	36
.057	131.9	1.19	8.3 . . . 8.8	36
1892.00	131.6	1.10	8.3 . . . 8.9	

θ Orionis.

R. A. 5h 29m 23s
Decl. — 5° 28′

A and B.

1888.862	31°.8	8″.66	. . .	36
.879	32.3	8.86	. . .	36
.895	32.7	8.70	. . .	36
1888.88	32.3	8.74	. . .	

A and C.

1888.862	131°.5	13″.00	. . .	36
.879	131.2	13.06	. . .	36
.895	131.1	12.79	. . .	36
1888.88	131.3	12.95	. . .	

D and C.

1888.856	240°.7	13″.23	. . .	36
.862	240.1	13.48	. . .	36
.879	241.1	13.35	. . .	36
1888.87	240.6	13.35	. . .	

D and B.

1888.862	299°.4	19″.35	. . .	36
.879	299.4	19.33	. . .	36
.895	299.7	19.50	. . .	36
1888.88	299.5	19.39	. . .	

B and C.

	°	″		
1888.862	162.9	16.87	...	36
.879	163.3	16.70	...	36
.895	162.7	16.71	...	36
1888.88	163.0	16.76	...	

A and D.

	°	″		
1888.862	95.3	21.57	...	36
.879	95.5	21.55	...	36
.895	95.4	21.54	...	36
1888.88	95.4	21.55	...	

A and E (Fifth star).

	°	″		
1888.862	352.0	4.28	...	36
.879	352.4	4.30	...	36
.895	350.1	4.36	...	36
1888.88	351.5	4.31	...	

C and F (Sixth star).

	°	″		
1888.854	121.3	4.05	...	36
.856	121.8	4.06	...	36
.862	119.5	3.86	...	36
1888.86	120.9	3.99	...	

Soon after the large telescope was mounted, Mr. ALVAN G. CLARK discovered a very faint star within the trapezium. It is a difficult object with the 36-inch, and certainly has never been seen before, notwithstanding the numerous alleged discoveries with telescopes down to three or four inches aperture. Not less than a dozen of these imaginary stars have been distributed about the interior of the trapezium, and some of them noted with instruments which failed to show the fifth and sixth stars. Mr. SADLER has given a diagram of these stars, so far as they can be located from the rather vague descriptions, none of them having been measured. It would be difficult to find now a real star which would not fall upon or near one of these places. I do not think the CLARK star can be fairly seen with an aperture very much less than that of the large telescope. Good atmospheric conditions are necessary, and in making the measures given below, it could not be seen on many nights, although the seeing appeared to be good enough to make the attempt. As to the light power of the 36-inch telescope, it is sufficient to refer to the new unequal pairs of the preceding list. These very minute companions, for example, *θ Ursae*, *o Ursae*, *β Draconis*, *μ Draconis*, 37 *Comae*, *τ Coronae*, *ξ Argus*, 47 *Bootis*, etc., are at least four or five times as bright as CLARK'S star, and correspondingly easier to see and measure. I have already stated in my measures with the Chicago 18½-inch that the trapezium was repeatedly examined by me during a period covering several years, and that I was never able to see the least trace of any of the interior stars claimed to have been seen. Certainly the new star would be far beyond the grasp of that telescope, perfect as it is for every kind of difficult work. It is a significant fact that some of the largest and best instruments in Europe failed to show any of the supposed new stars soon after their announcement.

In this connection it may be of interest to cite the principal communications to astronomical periodicals relating to the alleged discovery of stars within the trapezium of *Orion:*

Sadler.....*Engl. Mech.*, xxxiv., 448.—*Sid. Mess.*, vii., 217.
Lassell.....*Mon. Not.*, xvii., 68; xxii., 164, 276.
Common.....*Ast. Reg.*, xviii., 116.
D'Abbadie.....*Mon Not.*, xvii., 245, 266.
Huggins.....*Mon. Not.*, xxvi., 71; *Ast. Reg.*, v., 54.
Gill.....*Mon. Not.*, xxvii., 315.
Buckingham...*Mon. Not.*, xxxiii., 228.
Tempel.....A.N., 1898.
Denning.....A.N., 1915; *Obsy.*, Ill., 356.
Porro.....A.N., 1091.
Salter.....*Ast. Reg.*, viii., 60, 96.
Denning.....*Ast. Reg.*, ix., 37.
Key.....*Ast. Reg.*, iv., 134.
Byles.....*Obsy.*, v., 86.

The measures of the new star are as follows:

C and G (CLARK'S star).

	°	″		
1888.856	31.7	7.66	..	36
.928	32.7	7.31	.. 16.0	36
1889.049	37.9	7.81	.. 16.0	36
.077	32.6	6.83	.. 16.0	36
1888.98	33.9	7.40	.. 16.0	

D and G.

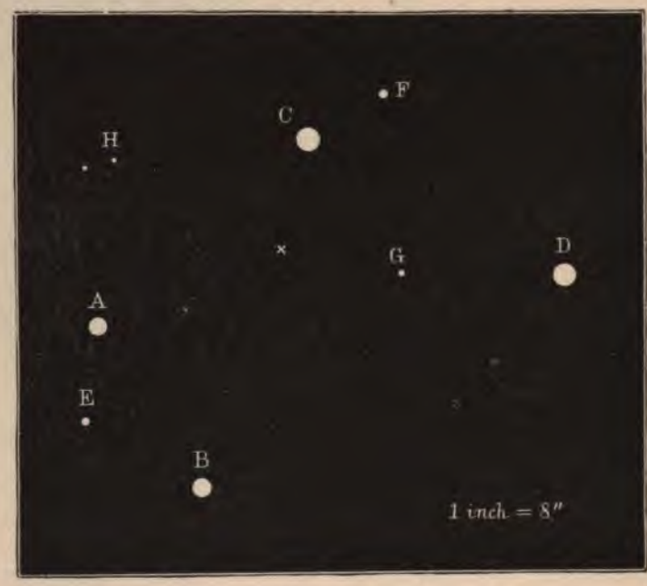
	°	″		
1888.856	273.1	7.45	..	36
.928	267.9	7.12	..	36
1889.049	272.1	6.56	..	36
.077	269.1	6.99	..	36
1888.98	270.5	7.03	..	

While the foregoing measures were being made, Mr. E. E. BARNARD, of this Observatory, detected another new star just outside of and preceding

the trapezium, and upon a careful examination discovered that this excessively faint star was itself double. I was only able to see it on one night, and then made a fairly satisfactory measure, considering the extraordinarily difficult character of the object. It is infinitely more difficult than any double star I have ever attempted to see or measure; and certainly could not be seen by me with any smaller telescope. I could not see it double on any other night on which measures were made. Only the most perfect atmospheric conditions are equal to so minute a pair, and even then it would be overlooked by the most experienced observers not possessing Mr. BARNARD'S rare acuteness of vision.

Mr. BARNARD has also discovered another excessively faint star within the trapezium on the line joining the bright stars *B* and *C*, and nearer the latter. I have not been able to see it, at least not with certainty, but I have no doubt of its existence, and hope to be able to measure it hereafter.

The accompanying diagram shows the relative positions of the stars of this interesting group as determined by the foregoing measures. A comparison of these measures with those made by Σ, HALL, and others, shows, beyond question, that the six principal stars are absolutely fixed with reference to each other, so far as any change is concerned which could be detected by observations covering more than half a century.



For the purpose of making an accurate map, I had intended to connect each of the small stars near the trapezium with the bright stars by measuring the position-angles from two points, but after a few observations it was given up as using time which could be better employed elsewhere. Of the stars observed in this way, four are north of the trapezium and three south. These are all comparatively bright stars, and are probably found in the catalogues of stars in this region.

A and H (BARNARD'S star).

1888.928	178°.6	7″.74	. . 16.0	36
1889.077	178.2	8.14	. . 16.0	36
1889.00	178.4	7.94	. . 16.0	

C and H.

1888.928	275°.1	9″.17	. .	36
1889.049	276.1	8.41	. .	36
.077	275.7	8.29	. .	36
1889.02	275.6	8.62	. .	

H and H.

1889.073	274°.0	1″.32	16.0 . . 16.5	36

1888.895	52°.7	B and a
.895	17.7	D and a
.895	48.6	B and b
.895	22.1	D and b
.895	335.5	A and c

1888.895	305°.8	B and c
.895	350.8	A and d
.895	326.4	B and d
.928	195.1	C and e
.928	176.1	A and e
.928	140.7	C and f
.928	190.2	D and f
.928	115.8	C and g
.928	143.5	D and g.

β 1032. σ Orionis.

R. A. $5^h\ 32^m\ 43^s$
Decl. $-\ 2°\ 40'$

A and B.

1890.785	348°.6	0".31	4.0 . . . 5.0	36
.829	351.6	0.30	. . .	36
.832	354.6	0.25	. . .	36
1891.766	349.4	0.19	. . .	36
.810	348.3	0.24	. . .	36
1892.057	341.4	0.25	. . .	36

The mean results are:

1888.81	357°.0	0".26	4 n
1890.81	351.6	0.29	3 n
1891.88	349.7	0.23	3 n

Measures of the distant companions, constituting Σ 762, will be found in the Fourteenth Catalogue of new pairs (β 1032).

β 1007. 126 Tauri.

R. A. $5^h\ 34^m\ 22^s$
Decl. $+\ 16°\ 28'$

1890.785	Single with 1000.
1891.791	At times seems to be elongated a little, but uncertain.
1892.060	Perhaps a slight elongation in 330° with 1900, but too close to measure if real.

The above observations were all made with the 36-inch telescope. Probably in rapid motion.

β 14.

R. A. $5^h\ 35^m\ 8^s$
Decl. $+\ 29°\ 48'$

1891.903	194°.2	5".79	8.0 . . 10.5	36
.906	194.8	5.79	7.8 . . 10.0	36
1891.90	194.5	5.79	7.9 . . 10.2	

Without change.

β 752.

R. A. $5^h\ 39^m\ 0^s$
Decl. $+\ 47°\ 46'$

1890.660 This star is certainly not double.

This was suspected to be a very close pair with the 6-inch on Mount Hamilton in 1879.

β 91.

R. A. $5^h\ 40^m\ 29^s$
Decl. $+\ 20°\ 54'$

1891.884	79°.9	1".67	8.2 . . 10.0	36
.903	80.9	1.74	8.0 . . 10.0	36
1892.022	81.9	1.83	8.0 . . 10.0	36
1891.93	80.9	1.75	8.1 . . 10.0	

No sensible change.

β 559.

R. A. $5^h\ 40^m\ 36^s$
Decl. $+\ 0°\ 2'$

A and B.

1891.903	84°.0	2".05	. . 11.8	36
.958	84.4	1.88	. . 11.0	36
1891.93	84.2	1.96	. . 11.4	

A and C.

1891.893	202°.1	50".33	9.0 . . . 8.9	36
.903	202.1	50.34	9.4 . . . 9.3	36
.958	201.5	50.34	9.5 . . . 9.5	36
1891.92	201.9	50.34	9.3 . . . 9.2	

In the nebula 78 M.

β 892.

R. A. $5^h\ 40^m\ 38^s$
Decl. $+\ 17°\ 41'$

1891.882	276°.3	1".17	9.0 . . 10.5	36
.903	276.1	1.12	9.0 . . 10.3	36
1891.89	276.2	1.15	9.0 . . 10.4	

Probably unchanged.

β 192. τ Aurigae.

R. A. $5^h\ 40^m\ 52^s$
Decl. $+\ 39°\ 8'$

A and B.

1892.022	351°.9	39".38	. . 12.5	36
.036	352.1	39.20	. . 11.3	36
1892.03	352.0	39.29	. . 11.9	

A and C (=*H V.* 21).

1892.022	33°.7	47".85	. . 11.5	36
.036	32.9	48.07	. . 10.7	36
1892.03	33.3	47.96	. . 11.1	

β 92.

R. A. $5^h\ 40^m\ 57^s$
Decl. $+\ 21°\ 4'$

1892.022	170°.3	9".16	8.7 . . . 9.5	36
.036	169.5	9.32	8.5 . . . 9.7	36
1892.03	169.9	9.24	8.6 . . . 9.6	

OΣ 118.

R. A. $5^h\ 41^m\ 13^s$
Decl. $+\ 20°\ 50'$

A and B.

1891.903	318°.4	0".75	8.0 . . . 8.7	36
1892.022	320.9	0.66	8.0 . . . 9.0	36
.036	316.6	0.70	8.0 . . . 8.7	36
1891.99	318.6	0.70	8.0 . . . 8.8	

A and C.

1891.903	161°.9	75".10	. . . 8.2	36
1892.036	161.1	75.50	. . . 8.5	36
1891.97	161.5	75.30	. . . 8.3	

β 561.

R. A. $5^h\ 41^m\ 18^s$
Decl. $+\ 12°\ 22'$

1891.958	2°.9	19".31	7.0 . . 11.5	36
1892.022	3.6	19.75	. .	36
.036	3.6	19.36	7.0 . . 13.0	36
1892.00	3.4	19.47	7.0 . . 12.0	

β 560.

R. A. $5^h\ 41^m\ 37^s$
Decl. $+\ 29°\ 41'$

1892.055	169°.9	0".63	8.0 . . . 8.5	36
.057	173.0	0.62	8.0 . . . 8.3	36
.151	173.6	0.59	8.0 . . . 8.7	36
.153	173.0	0.59	8.0 . . . 8.5	36
1892.10	172.4	0.60	8.0 . . . 8.5	

Apparently rapid change in angle and distance.

β 93.

R. A. $5^h\ 41^m\ 33^s$
Decl. $+\ 21°\ 2'$

A and B.

1891.845	121°.6	59".92	8.4 . . .	36
.854	121.8	60.14	8.3 . . .	36
1891.85	121.7	60.03	8.3	

B and C.

1891.845	165°.9	5".66	9.0 . . 11.0	36
.854	168.1	5.77	9.5 . . 11.5	36
1891.85	167.0	5.71	9.2 . . 11.2	

B and D.

1891.845	323°.3	9".46	. . 11.0	36
.854	324.0	9.41	. . 11.5	36
1891.85	323.6	9.43	. . 11.2	

No other measures.

β 405.

R. A. $5^h\ 42^m\ 22^s$
Decl. $-\ 13°\ 34'$

1892.036	127°.3	14".34	8.2 . . 11.5	36
.039	126.4	14.57	8.5 . . 11.8	36
1892.04	126.8	14.45	8.3 . . 11.6	

Unchanged.

β 406.

R. A. $5^h\ 43^m\ 1^s$
Decl. $-\ 13°\ 28'$

1891.958	241°.6	11".05	8.5 . . 11.0	36
1892.036	242.7	11.43	8.5 . . 11.5	36
.039	242.5	11.69	9.0 . . 11.5	36
1892.00	242.3	11.39	8.7 . . 11.3	

β 95.

R. A. $5^h\ 46^m\ 8^s$
Decl. $-\ 7^\circ\ 20'$

1891.958	294°.9	13″.81	8.0 . . 10.0	36
1892.036	297.3	13.97	8.5 . . 12.0	36
1892.00	296.1	13.89	8.2 . . 11.0	

β 563.

R. A. $5^h\ 47^m\ 46^s$
Decl. $+\ 15^\circ\ 29'$

1891.958	185°.4	6″.67	8.0 . . 10.0	36
1892.022	184.6	6.31	8.2 . . 11.5	36
.036	185.5	6.58	8.2 . . 11.0	36
1892.00	185.2	6.52	8.1 . . 10.8	

α Orionis.

R. A. $5^h\ 48^m\ 40^s$
Decl. $+\ 7^\circ\ 23'$

A and B.

1891.810	109°.3	40″.16	. . 14.0	36
1892.055	109.7	39.52	. . 15.0	36
1891.98	109.5	39.84	. . 14.5	

A and C.

1891.810	289°.9	61″.55	. . 14.0	36
1892.055	289.7	62.48	. . 14.5	36
1891.98	289.8	62.01	. . 14.2	

A and D.

1891.810	347°.6	76″.83	. . 13.5	36
1892.055	347.8	76.71	. . 13.5	36
1891.98	347.7	76.77	. . 13.5	

The nearest stars, *B* and *C*, have not been seen before. *D* was found with the 18½-inch. HERSCHEL'S companion is much farther away.

S 503.

R. A. $5^h\ 49^m\ 10^s$
Decl. $+\ 13^\circ\ 56'$

A and B.

1889.096	9°.1	3″.40	7.0 . . . 8.0	36
.104	8.8	3.32	7.0 . . . 8.0	36
.128	7.9	3.36	7.0 . . . 8.0	36
1889.11	8.6	3.36	7.0 . . . 8.0	

A and C.

1889.096	163°.1	20″.83	. . 10.5	36
.104	163.7	21.04	. . 11.0	36
.128	162.9	20.89	. . 11.0	36
1889.11	163.2	20.92	. . 10.8	

An interesting object from the proper motion of the larger star. The minimum distance must have been reached not far from 1883, and the nearer stars are now drifting apart. There are no measures between those of SOUTH in 1825 and DEMBOWSKI'S in 1873. The former measured a distant star (201″.76), which in 1883 I found was 234″.09 from *A*. The small star, *C*, was first measured by me in 1878.

A and B.

1825.07	134°.1	39.94	*S*	2 n
1873.93	120.1	8.08	Δ	3 n
1881.18	99.3	3.58	β	3 n
1883.11	82.6	2.90	β	3 n
1889.11	8.6	3.36	β	3 n

A and C.

1878.00	157°.3	28″.09	β	1 n
1883.10	158.8	24.61	β	4 n
1889.11	163.2	20.92	β	3 n

β 564.

R. A. $5^h\ 54^m\ 59^s$
Decl. $-\ 1^\circ\ 34'$

1892.036	71°.2	1″.28	9.0 . . 10.0	36
.055	70.6	1.30	9.0 . . 11.0	36
1892.04	70.9	1.29	9.0 . . 10.5	

β 1056. μ Orionis.

R. A. $5^h\ 55^m\ 47^s$
Decl. $+\ 9^\circ\ 39'$

1890.775	272°.4	17″.01	4.0 . . 14.0	36
.840	273.1	17.17	4.0 . . 15.0	36
.974	272.5	17.15	. . 13.5	36
1890.86	272.7	17.11	. . 14.2	

β 893.

R. A. $5^h\ 56^m\ 49^s$
Decl. $+\ 37^\circ\ 58'$

1892.055	129°.2	18″.12	6.5 . . 13.0	36
.088	131.8	17.78	6.0 . . 12.0	36
1892.07	130.5	17.95	6.2 . . 12.5	

β 17. 4 Moncerotis.

R. A. 6h 2m 48s
Decl. — 11° 8′

A and B.

1891.969	181°.3	3″.13	6.0 . . 10.5	36
1892.036	180.2	3.23	6.0 . . 10.0	36
.055	179.6	3.26	6.0 . . 10.8	36
1892.02	180.4	3.21	6.0 . . 10.4	

A and C.

1891.969	246°.4	8″.75	. . 10.8	36
1892.036	246.7	9.05	. . 10.5	36
.055	247.4	8.52	. . 11.9	36
1892.02	246.8	8.77	. . 10.8	

β 1058. 4 Geminorum.

R. A. 6h 3m 13s
Decl. + 23° 1′

1890.939	283°.0	0″.27	6.1 . . . 6.2	36
1891.052	277.7	0.27	6.5 . . . 6.6	36
.055	283.3	0.31	6.3 . . . 6.5	36
1891.01	281.3	0.28	6.3 . . . 6.4	
1891.810	281.2	0.28	6.5 . . . 6.6	36
.854	281.1	0.33	. . .	36
.859	287.0	0.28	6.5 . . . 6.6	36
1891.84	283.1	0.30	6.5 . . . 6.6	

Comparing these measures with those of 1889, a change in the distance seems probable.

1889.13	104°.3	0″.41	β	2 n

β 565.

R. A. 6h 3m 41s
Decl. — 14° 3′

1892.036	101°.0	1″.23	8.2 . . . 8.8	36
.057	101.1	1.10	8.0 . . . 9.0	36
.115	97.7	1.05	8.0 . . . 9.5	36
1892.07	99.9	1.13	8.1 . . . 9.1	

A. C. 3.

R. A. 6h 5m 47s
Decl. — 4° 38′

1892.036	173°.1	0″.86	7.0 . . . 8.5	36
.057	172.2	0.80	7.5 . . . 9.2	36
.115	176.1	0.96	7.0 . . . 8.5	36
1892.07	173.8	0.87	7.2 . . . 8.7	

Discovered by ALVAN CLARK.

β 1017.

R. A. 6h 6m 28s
Decl. — 2° 56′

1892.036	163°.4	0″.63	8.5 . . . 8.8	36
.055	160.3	0.63	8.5 . . . 8.8	36
.057	159.6	0.68	8.4 . . . 8.8	36
1892.05	161.1	0.65	8.5 . . . 8.8	

No other measures.

β 1008. η Geminorum.

R. A. 6h 7m 38s
Decl. + 22° 32′

1889.104	294°.6	1″.34	3.0 . . 10.0	36
.134	291.8	1.00	. . 11.0	36
.173	298.1	0.79	. .	12
1890.903	295.3	1.12	3.5 . . 11.0	36
.939	295.5	1.11	. . 11.0	36
.955	297.6	1.02	. . 10.0	36

The mean results are:

1889.14	294°.8	1″.04	3 n
1890.93	296.1	1.08	3 n

β 566.

R. A. 6h 8m 41s
Decl. — 4° 32′

1892.036	215°.5	1″.54	6.5 . . 13.0	36
.057	205.1	2.04	6.7 . . 12.5	36
.115	209.0	2.04	6.4 . . 12.0	36
1892.07	209.9	1.87	6.5 . . 12.5	

β 193.

R. A. 6h 9m 10s
Decl. + 4° 0′

1892.036	90°.2	17″.89	8.0 . . 11.0	36
.055	90.3	17.87	8.0 . . 11.0	36
1892.04	90.2	17.88	8.0 . . 11.0	

β 1018.

R. A. 6h 10m 6s
Decl. — 2° 50′

1892.055	54°.4	6″.10	8.5 . . 11.5	36
.057	54.2	6.06	8.5 . . 12.0	36
.085	55.4	5.89	8.4 . . 11.5	36
1892.06	54.7	6.02	8.5 . . 11.7	

No other measures.

β 96. 75 Orionis.

R. A. $6^h\ 10^m\ 29^s$
Decl. $+\ 9^\circ\ 59'$

C and D.

1892.088	224°.9	4".90	9.0	11.0	36
.153	229.2	5.30	9.0	10.5	36
1892.12	227.0	5.10	9.0	10.7	

A and C.

1892.088	159°.6	120".16	6.0		36
.153	159.5	119.64	6.0		36
1892.12	159.5	119.90	6.0		

A and B.

1892.088	255°.1	62".80		10.5	36
.153	255.9	62.96		10.0	36
1892.12	255.5	62.88		10.2	

β 1019.

R. A. $6^h\ 11^m\ 26^s$
Decl. $-\ 3^\circ\ 0'$

1892.055	271°.7	0".74	8.0	9.3	36
.057	276.4	0.92	8.0	10.0	36
.085	274.5	0.78	8.0	9.5	36
1892.06	274.2	0.81	8.0	9.6	

No other measures.

β 567.

R. A. $6^h\ 9^m\ 34^s$
Decl. $-\ 4^\circ\ 53'$

1891.958	246°.3	3".94	7.7	11.0	36
1892.036	247.7	4.07	6.8	11.0	36
.055	246.3	3.89	6.8	10.8	36
1892.00	246.8	3.97	7.1	10.9	

β 895.

R. A. $6^h\ 12^m\ 23^s$
Decl. $+\ 28^\circ\ 29'$

A and B.

1891.091	144°.3	0".20	8.2	8.3	36
.225	144.7	0.20	...		36
.227	144.7	0.25	...		36
.766	148.9	0.22	8.0	8.2	36
.785	144.7	0.20	8.0	8.2	36
.791	144.5	0.20	8.2	8.4	36

AB and C (= Σ 888).

1891.225	249°.8	2".78	...	36
.227	255.7	2.96	...	36
1891.22	250.2	2.87		

The means of the measures of the close pair are:

1891.18	144°.6	0".22	3 n
1891.78	146.0	0.21	3 n

β 1020.

R. A. $6^h\ 15^m\ 46^s$
Decl. $+\ 28^\circ\ 49'$

1891.225	158°.9	1".23	8.0	10.0	36
.227	158.1	1.31	8.5	10.0	36
1891.22	158.5	1.27	8.2	10.0	

No other measures.

β 753. λ Canis Majoris.

R. A. $6^h\ 23^m\ 40^s$
Decl. $-\ 32^\circ\ 30'$

1892.057	49°.3	1".32	5.5	7.0	36
.184	45.4	1.29	6.0	8.5	12
.186	47.0	1.27	6.0	7.5	36
1892.14	47.2	1.29	5.8	7.7	

No other measures.

β 754.

R. A. $6^h\ 30^m\ 22^s$
Decl. $-\ 33^\circ\ 55'$

1892.184	38°.3	0".86	8.0	8.2	12
.186	34.7	0.71	8.0	8.3	36
1892.18	36.5	0.78	8.0	8.2	

No other measures.

β 571.

R. A. $6^h\ 33^m\ 2^s$
Decl. $+\ 13^\circ\ 5'$

1892.036	317°.6	3".09	6.8	11.5	36
.115	317.5	2.96	6.8	11.0	36
.153	318.7	2.95	7.0	11.0	36
1892.10	317.9	3.00	6.9	11.2	

No. 237.

R. A. $6^h\ 35^m\ 47^s$
Decl. $+\ 3^\circ\ 22'$

1890.939 No double star found here. All the stars round.

HOUGH describes this as an equal pair of $7^m.5$ stars, with a distance of $0''.3$. There is certainly no double star in or near this place. All the stars in the vicinity were examined.

A.G.C. 1. Sirius.

R. A. $6^h\ 39^m\ 53^s$
Decl. $-\ 16^\circ\ 33'$

1888.818	15.1	5.25	...	36
.856	16.5	5.33	...	36
1889.049	11.0	5.28	...	36
.052	14.5	5.27	...	36
.077	12.6	5.24	...	36
1888.97	13.9	5.27	...	
1890.252	359.6	4.17	...	36
.269	361.6	4.20	...	36
.304	356.8	4.19	...	36
1890.27	359.7	4.19	...	

1890.785 The seeing seems to be very good, and although *Sirius* is perhaps an hour and a half from the meridian, apparently the companion should be seen, if it can be seen at all, this year.

.829 Followed it a long time, using various powers, but could not see anything of the companion. The seeing is excellent.

.840 Followed *Sirius* for some time under favorable conditions. The companion could not be seen.

.939 Fine seeing. Tried all powers; no trace of the small star.

1891.766 Splendid seeing. Tried all powers without seeing any trace of the companion. It is hardly worth while to examine it any further this year.

SIRIUS.

[From *Monthly Notices, R. A. S.*, April, 1891.]

It may not be generally known, even by those who have given special attention to observing or investigating the *Sirius* system, that all the collections of the measures of the companion hitherto published are not only very incomplete, with respect to the number of measures which have been made, but contain many material errors in the observations quoted and made use of. Errors of one sort and another, first made long ago, have been handed down, and remaining unchallenged, have come to be overlooked altogether. Many years ago I undertook to collect all the measures that have been made of every known double star, and the more important notes and papers referring to them, and have since added the current measures and observations, so that the history of each double star is substantially complete to this time. I have endeavored to make these references to *Sirius* cover the various points of interest connected with it as a double star, commencing with the investigation which resulted in the discovery of the companion by Mr. ALVAN G. CLARK, and especially to include all measures of the small star since the first observation in 1862. The time will soon come when a complete list of these measures will be more important than it has been heretofore, for the close determination of the real period of this interesting binary. Down to this time the result must necessarily be only approximate, since the companion has moved through less than 90° of its orbit, and the real dimensions of the apparent ellipse cannot be rigidly determined. In a few years more, and probably as soon as the companion can be seen by any telescope now in use, it will have added 180° to the arc already passed over, and then a single measure will enable the period to be computed with a very small percentage of error. This important additional measure I trust can be made with the LICK telescope within the next four or five years.

In view of the new interest which this system will then have for both the observer and the computer, I have thought it important to make as perfect a collection as possible of the published observations for the benefit of all concerned. In nearly every instance I have referred to the original publication, and there obtained the figures here given. In many cases this has been necessary to avoid the errors frequently made by taking

the measures from second-hand sources. As an illustration of this, I may mention one or two examples.

In some of the collected observations, CHALLIS is credited with having measured the companion in 1862. As a matter of fact he did not measure it, and, so far as I know, never attempted to. This measure was really made by CHACORNAC. GLEDHILL gives a different result to both CHALLIS and CHACORNAC, which doubtless led to a repetition of the same error by GORE and HOWARD in their computations of the orbit.

Each one of these authorities has given a set of measures by MITCHEL as made in 1863. This is an obvious mistake, as it is well known that General MITCHEL for some time previous to this was in the military service of the United States, and engaged in the more important work of suppressing the rebellion. He died in October, 1862. These measures were really made by MARTH, not in 1863, but in 1864. MARTH did not observe *Sirius* in 1863 at all, although he is put down as having done so by authors previously referred to.

GORE gives a measure in 1885 credited to the Paris Observatory; and HOWARD includes this with the measures used in computing a new orbit published a few weeks ago (GOULD'S *Astronomical Journal*, 235), and also gives a measure in 1884 from the same observatory. These two measures are as follows:

1884.27	36.3	8.70	Paris Obs.
1885.11	34.1	8.09	Paris Obs.

Now, these two measures are identical in date, angle, and distance with the observations of YOUNG in 1884 and 1885, and as I have found no authority elsewhere for these measures, I conclude that they should have been credited to Princeton instead of Paris.

To enable those who wish to consult these measures to do so conveniently, I have given, following the measures, a complete list of the works in which every measure cited can be found. The authors of the papers are given in alphabetical order, but the names of all the observers do not appear in this way, as in some instances the measures of other observers are included under one name. It should be remarked also that some of the references do not relate to micrometrical measures, but have some other special interest, and should be included in a list of valuable papers on *Sirius*.

The following are the measures I have collected:

Measures of Sirius.

1862.

1862.19	84.6	10.07	Bond	3 n
.20	85.0	10.09	Rutherfurd	5 n
.23	84.5	10.42	Chacornac	2 n
.28	83.8	(4.92)	Lassell	1 n

1863.

1863.21	82.5	10.15	Otto Struve	2 n
.15	88.4	7.63	Secchi	1 n
.21	81.3	9.54	Rutherfurd	6 n
.23	84.9	10.00	Dawes	1 n
.27	82.8	. . .	Bond	1 n

1864.

1864.14	79.4	10.60	Marth	3 n
.18	80.1	9.63	Lassell	1–3 n
.22	78.6	10.70	Bond	4–2 n
.22	74.8	10.92	Otto Struve	6–3 n
.23	84.9	. . .	Dawes	1 n
.24	79.7	10.08	Winnecke	1 n

1865.

1865.10	76.8	. . .	Lassell & Marth . .	3 n
.21	77.6	10.59	Otto Struve	2 n
.22	75.5	9.59	Secchi	8 n
.23	77.8	10.77	Förster	5–4 n
.25	76.9	. . .	Tietjen	3 n
.26	76.0	. . .	Bond	——
.26	76.9	(9.0)	Engelmann	1 n

1866.

1866.07	77.2	10.43	Knott	2–1 n
.21	. . .	10.74	Bruhns	1 n
.21	75.2	10.93	Otto Struve	3 n
.22	73.9	10.97	Tietjen	2–1 n
.23	74.1	11.29	Förster	3–1 n
.23	74.0	10.21	Hall	2–3 n
.23	74.9	10.57	Newcomb	3 n
.25	78.3	10.34	Tuttle	1 n
.26	74.7	10.09	Eastman	3 n
.29	71.3	10.11	Secchi	3 n

1867.

1867.02	74.2	11.15	Winlock	7–6 n
.10	73.8	10.66	Searle	6–5 n
.22	72.1	10.98	Otto Struve	1 n
.24	72.3	. . .	Förster	2 n
.27	74.9	9.92	Eastman	2–1 n

1868.

1868.02	73.2	10.25	Searle	2 n
.04	72.1	...	Peirce	1 n
.23	70.3	11.25	Vogel	7 n
.24	69.6	11.35	Bruhns	5 n
.26	71.7	10.95	Engelmann	5 n

1869.

1869.10	74.7	10.26	Brünnow	7–4 n
.15	73.6	11.23	Vogel	3 n
.20	68.6	11.17	Dunér	1 n
.20	68.6	11.07	Winlock	2 n
.23	69.4	10.93	Peirce	1 n

1870.

1870.13	68.1	11.16	Peirce	12–4 n
.17	65.9	11.06	Winlock	7–5 n
.24	65.1	12.06	Vogel	5 n

1871.

1871.16	65.9	10.75	Secchi	3 n
.20	70.3	11.19	Peirce	2–1 n
.23	64.1	11.11	Dunér	2 n
.25	60.1	12.10	Pechüle	4–3 n

1872.

1872.18	59.8	11.05	Dunér	2 n
.21	66.6	10.69	Börgen	3 n
.24	62.4	11.50	Newcomb	1 n
.24	64.3	11.46	Hall	6 n
.26	61.3	...	Skinner	3 n

1873.

1873.20	65.8	11.12	Hall	1 n
.22	60.8	10.57	Dunér	1–4 n
.23	70.0	9.80	Börgen	1 n
.23	66.3	10.42	Bruhns	1 n

1874.

1873.93	65.0	11.29	Wilson & Seabroke	1 n
1874.16	59.0	11.46	Newcomb	7 n
.19	58.7	10.99	Holden	2–1 n
.23	58.0	11.10	Hall	2 n

1875.

1874.83	57.5	...	Burton	1 n
1875.19	57.1	10.73	Dunér	4 n
.21	56.6	11.41	Newcomb	2 n
.21	55.9	11.89	Holden	5–4 n
.28	56.4	11.08	Hall	4 n

1876.

1876.03	57.8	11.12	Watson	1 n
.05	54.6	11.45	Peters	1 n
.09	54.9	11.82	Holden	6 n
.14	55.0	11.55	Russell	4 n
.22	55.2	11.19	Hall	6 n

1877.

1877.11	52.8	11.19	Cincinnati	4–3 n
.16	52.8	11.35	Holden	4 n
.26	53.4	10.95	Hall	5 n

1878.

1877.97	52.4	10.83	Burnham	8 n
1878.07	50.5	11.07	Holden	4 n
.15	51.0	10.71	Cincinnati	9 n
.19	54.4	11.24	Pritchett	5 n
.22	53.2	11.40	Eastman	3 n
.24	51.7	10.76	Hall	5 n

1879.

1878.70	50.0	10.61	Cincinnati	20–14 n
1879.05	50.7	10.44	Burnham	10 n
.12	47.8	11.35	Holden	5 n
.15	50.3	10.78	Pritchett	5 n
.20	50.1	10.55	Hall	6 n

1880.

1879.75	46.5	10.29	Cincinnati	1 n
1880.00	48.8	10.55	Russell	1 n
.04	50.2	10.40	Gledhill	1 n
.10	47.1	10.48	Holden	4 n
.11	48.3	10.00	Burnham	11 n
.17	49.6	9.87	Hough	3 n
.18	46.7	9.92	Bigourdan	6–4 n
.22	51.1	...	Smith	1 n
.25	47.8	10.30	Hall	8 n
.28	48.6	10.38	Frisby	2 n

1881.

1881.07	46.3	9.77	Burnham	8 n
.12	43.3	10.83	Holden	2 n
.14	44.3	10.02	Bigourdan	5–3 n
.16	46.8	9.80	Gledhill	4 n
.17	46.9	10.11	Frisby	6 n
.18	46.5	9.81	Young	7 n
.26	45.3	9.60	Hough	5 n
.26	45.3	10.00	Hall	6 n

1882.

1881.99	43°.6	9".38	Burnham	11 n
1882.13	43.1	9.30	Hough	9 n
.13	42.4	9.76	Bigourdan	4–3 n
.18	42.2	9.95	Frisby	6 n
.23	42.5	9.67	Hall	7 n
.54	44.0	...	Engelmann	6 n

1883.

1883.10	40°.1	9".05	Burnham	10 n
.10	39.0	9.41	Young	1 n
.12	39.7	9.02	Hough	11 n
.14	41.3	...	Wilson	4 n
.17	41.4	9.75	Frisby	7 n
.19	39.9	9.10	Bigourdan	2–1 n
.21	39.1	9.26	Hall	6 n

1884.

1884.05	36°.0	9".67	Perrotin	6 n
.17	35.3	8.79	Bigourdan	3–1 n
.18	36.7	9.51	Hough	11 n
.19	36.4	8.39	Burnham	10 n
.23	37.7	8.81	Hall	8 n
.27	36.3	8.70	Young	5 n

1885.

1885.11	34°.1	8".09	Young	8 n
.20	32.7	7.96	Hough	10 n
.27	34.7	8.06	Hall	8 n

1886.

1886.05	29°.8	7".59	Young	4 n
.14	28.7	7.21	Hough	12 n
.22	30.6	7.39	Hall	6 n

1887.

1887.14	25°.4	7".08	Young	4 n
.19	23.7	6.78	Hough	7 n
.23	24.2	6.51	Hall	4 n

1888.

1888.24	23°.3	5".78	Hall	3 n

1889.

1888.97	13°.9	5".27	Burnham	5 n

1890.

1890.27	359°.7	4".19	Burnham	3 n

REFERENCES TO MEASURES OF SIRIUS.

Abbe . . . . . *Mon. Not.*, xxviii., 2.

Auwers . . . . . *Mon. Not.*, xxii., 145, 148; xxv., 38 (Orbit).—A.N. 1371, 1506.—*Monatsberichte der Berliner Akademie*, 1866.

Bigourdan . . . . . *Annals de l'Observatoire de Paris* (Observations of 1883).

Bond . . . . . *Am. Jour. Sci.*, 2d series, xxxiii., 286.—*Mon. Not.*, xxii., 170.—A.N. 1353, 1374.

Burnham . . . . . *Double star observations made at the Dearborn Observatory, 1877–8. Mems. R. A. S.*, xliv.—*Double star observations made at the Dearborn Observatory, 1878–9. Mems. R. A. S.*, xlvii.—*Mon. Not.*, xlii., 384; xliii., 318; xliv., 365; li., 378.—A.N., 2189, 2314, 2371, 2884, 2929, 2979, 3048.

Bessel . . . . . *Mon. Not.*, vi., 136.

Bouris . . . . . *Ergänzungsheft zu den Ast. Nach.*, 121.

Bruhns . . . . . A.N. 1696 (measures by Bruhns, Vogel, and Engelmann).—*Pub. Universitats Sternewarte zu Leipzig. Heft., 1882* (measures by Bruhns and Börgen).

Burton . . . . . *Copernicus* I., 54.

Brünnow . . . . . *Astronomical observations made at the Observatory of Trinity College*, Dublin, 1868–9, part I.

Chacornac . . . . . A.N. 1355, 1368,—*Mon.Not.*, xxv., 40, 42.

Cincinnati . . . . . *Publications of the Cincinnati Observatory*, Nos. 4, 5, and 6.

Cruls . . . . . *Annales de l'Observatoire Impérial Rio de Janeiro*, vol. iv., part I.

Colbert . . . . . *Annual Report of G. W. Hough, Director of the Dearborn Observatory*, for 1885-6 (Orbit).

Dawes . . . . . *Mon. Not.*, xxiii., 202; xxiv., 144.

Dunér . . . . . *Mesures Micrométriques à l'Observatoire de Lund*, 1876.—A.N. 1844.

Eastman . . . . . *Mon. Not.*, xxxviii., 360.—A.N., 1680.

Engelmann . . . . A.N. 1526, 2678.

Ferrari . . . . . *Terza serie delle misure micrometriche delle stelle doppie, fatte all' equatoriale del Collegio Romano*, 1872–4.

Förster . . . . . A.N. 1530, 1592.—*Monatsberichte der Berliner Akademie*, 1865.

Flammarion . . . *Ast. Reg.*, xv., 186.—*Comp. Rend.*, 1879. *L'Astronomie*, iii., 41.

Gore . . . . . *Mon. Not.*, xlix., 420 (Orbit).—*Catalogue of binary stars for which orbits have been computed.* Proc. Royal Irish Acad., 1891. (Contains all the orbits of *Sirius*. Plummer's orbit is erroneously credited to Pritchard, and the same mistake is made in Houzeau's *Vade-Mecum de l'Astronomie.*)

Goldschmidt . . . *Comp. Rend.*, lvi., 436.—*Mon. Not.*, xxiii., 181, 243.—A.N. 1423 (mythical companions).

Gyldén. . . . . A.N. 1536.

Hall.....*Double star observations, App. to Wash. Obs.*, 1877.—*Double star observations, App. to Wash. Obs.*, 1888.—*Mon. Not.*, xli., 416; xlii., 323; xliii., 330; xliv., 360; xlv., 426; xlvi., 454—*Am. Jour. Sci.*, June, 1880.—*Gould's Jour.*, 157.—*Sid. Mess.*, iii., 179.—*Am. Jour. Sci.*, xix., 457.—A.N. 1888, 1994, 2061, 2174, 2256, 2277.—*Washington observations*, 1880, 1884, 1886.

Harvard.....*Annals of the observatory of Harvard College*, vol. xiii., part I. (measures by Bond, Winlock, Searle, and Peirce).

Hough .....*Mon. Not.*, xliii., 371; xliv., 365; xlv., 427; xlvi., 393; xlvii., 478; A.N. 2978.

Howard .....*Gould's Ast. Journal*, 235 (Orbit).

Hunt.....*Observatory*, iii., 385, 580.

Knott .....*Mems., R. A. S.*, xliii.—*Mon. Not.*, xxvi., 243.

Laugier .....A.N., 1142.

Lassell .....*Mon. Not.*, xxiv., 145.—A.N., 1360.

Leavenworth ..*Publications of the McCormick Observatory*, vol. i, part IV.

Mädler .....A.N. 304.

Marth .....*Mon. Not.*, xxiv., 145.

Main .....*Mon. Not.*, xx., 202.

Mann .....*Sid. Mess.*, ii., 136; vii., 25.

Newcomb .....A.N. 1584. (See Washington.)

Peters.....A.N. 745–748, 1355.

Perrotin.....*Annales de l'Observatoire de Nice*, vol. ii.—A.N. 2684.

Pechüle .....A.N. 1855.

Pickering.....*Annals of the Harvard College Observatory*, vol. xi., parts I. and II. (Photometric).—A.N. 2366 (measures by Bond, Winlock, Searle, and Peirce).

Pritchett .....*Publications of the Morrison Observatory*, No. 1, 1885.—A.N. 2208.

Plummer .....*Mon. Not.*, xlii., 56 (Orbit).

Rutherfurd ....*Am. Jour. Sci.*, 2d series, xxxiv., 294; xxxv., 301, 407.

Russell.....*Sydney Observations*, 1871–82.

Secchi.....*Catalogo di 1321 Stelle doppie* (Appendix).—A.N. 1614.

Seabroke .....*Third Catalogue of Micrometrical Measures of Double Stars made at the Temple Observatory*. Mems. R. A. S., xlvi. (See Wilson.)

Struve, O. .....*Mon. Not.*, xxiv., 149; xxvi., 268.—*Mélanges Mathématiques et Astronomiques*, iii., 558 (including measures by Winnecke).

Safford .....*Mon. Not.*, xxii., 145; xxiii., 67.—*Proc. Am. Acad. Sci.*, 1863, 1866.

Tempel.....A.N. 1472, 2166.

Vogel .....A.N. 1767, 1804.

Washington ...*Washington Observations*, 1866, 1872–79. A.N., 1888, 2061, 2097, 2147, 2213, 2324 (measures by Hall, Holden, Newcomb, Eastman, and others).

Wilson, H. C...*Publications of the Cincinnati Observatory*, No. 10.

Wilson, J. M. ..*Observations of double stars at the Temple Observatory, Rugby*, by Wilson and Seabroke. Mems. R. A. S., xlii. (See Seabroke).—*Mon. Not.*, xxxiv., 484.

Young .....*Observatory*, iv., 183; x., 263.—*Sid. Mess.*, v., 182.

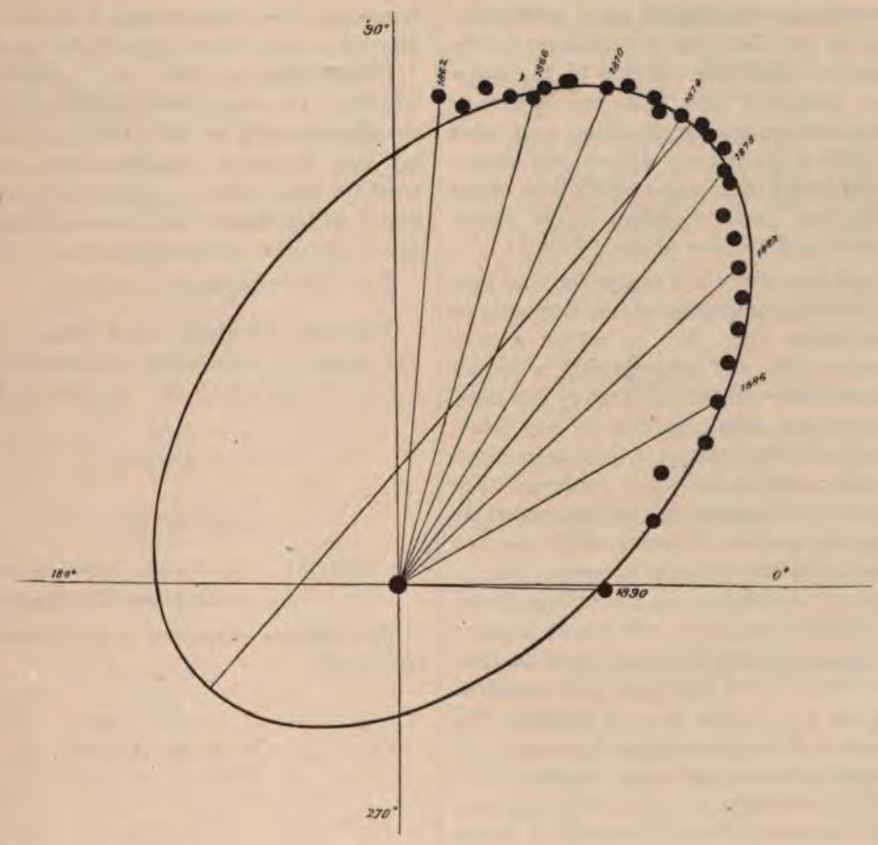
.....*Transactions Roy. Soc., Victoria*, vol. x., 69, 128 (distant stars).

The Period of Sirius.

Some early attempts were made to see how far the motion of the observed star agreed with the theoretical companion, but the arc described was so short, and the motion of the smaller star so nearly uniform, that no reliable result could be reached from the observations. An ellipse of almost any magnitude would satisfy the observed positions as well as one which agreed with that laid down for the theoretical star. In 1881 PLUMMER pointed out that a period of four hundred and forty years would represent the observations about as well as one of fifty years. Since that time the limits of the possible ellipses which could be drawn through the observed positions have been greatly narrowed by the later measures, and the uncertainty of the period of rotation correspondingly reduced.

Two orbits have been recently computed: One by GORE, using measures made each year down to 1889, who finds a period of 58.47 years; and the other by HOWARD, who includes the very last measures of the companion made here in 1890, and obtains a period of 57.02 years. Very few of the measures are used by the last-named computer, and some of the years are not represented at all. The measures are not always correctly given, and in one instance, at least, the error is a large one. This occurs in a set of measures made by me in 1877. The mean result was derived from measures on eight nights. Some of these were at the end of 1877, and some in the beginning of 1878. In the paper referred to these are given as two series, one embracing the observations of 1877, and the other those of 1878, with an error of 1″ in the latter distance. Of course these measures all belong together, and should be represented by a single mean, as given in the original publication.

The close agreement in the periods obtained by these independent investigations is worthy of note, and perhaps no better result could be got from the



SIRIUS

material available at this time. However, I have made a rough investigation in the same direction, which is given here for what it is worth. I have followed a plan, which differs somewhat from that usually adopted, in this: I have taken the complete series of measures given above, and deduced from the observations of each year a result which, in my judgment, would best represent, so far as the measures are concerned, the position of the companion. Of course this involved a consideration of the probable merits and value of each set of measures, as derived from the skill and experience of the observer, the size of the instrument used, the number of nights, and the general movement of the small star from the observations as a whole. It is not claimed that this method should be generally followed, since it would require a thorough familiarity with the relative value of measures by the different double-star observers, which many would have no opportunity of acquiring, but for the purpose I had in view in this instance it was certainly as good as any other.

The positions obtained in this manner are as follows:

	°	″		°	″
1862.20	85.0	10.08	1877.18	53.0	11.16
1863.22	82.9	9.90	1878.12	51.7	10.77
1864.20	79.6	10.38	1879.02	50.3	10.59
1865.22	77.0	10.32	1880.18	48.6	10.06
1866.21	74.5	10.39	1881.19	45.8	9.79
1867.17	73.4	10.68	1882.12	43.1	9.45
1868.16	71.4	10.95	1883.14	39.6	9.11
1869.17	71.0	10.93	1884.22	36.8	8.60
1870.15	67.0	11.11	1885.19	33.8	8.04
1871.21	65.1	11.29	1886.14	29.7	7.40
1872.22	62.2	11.34	1887.19	24.4	6.79
1873.21	60.8	11.12	1888.24	23.3	5.78
1874.19	58.6	11.18	1888.97	13.9	5.27
1875.22	56.5	11.28	1890.27	359.7	4.19
1876.22	55.2	11.19			

These positions were plotted on a sufficiently large scale to lay them down accurately to the decimal places. The time covered by the measures was separated into four-year intervals by the lines shown on the diagram; and after repeated trials a satisfactory ellipse was drawn which would make these areas equal, with slight changes in the position-angles. This ellipse gives a period of fifty-three years.

This result may not be any nearer the true time than the periods found by GORE and HOWARD, as it is undoubtedly true that an ellipse with a greater major axis, and consequently a longer period, would represent the arc already described by the companion about as well as any other. With reference to this matter, I have been influenced by one consideration which could not have been taken into account in the previous attempts to compute the period. I measured *Sirius* last year (1890) with the 36-inch telescope, but in consequence of my absence on the Eclipse Expedition to Cayenne, and the severe winter weather that prevailed on Mount Hamilton for some time after my return, *Sirius* was long past meridian before I could get it even in early twilight; the companion was therefore very hard to see at all, and the measures were made with extreme difficulty. This I attributed to the unfavorable conditions, and expected to have no trouble in seeing and measuring the small star this year. I have tried to get it this year under very favorable circumstances, when the most difficult and close pairs were comparatively easy, and have utterly failed to see the least trace of it; I am satisfied that it is now beyond the reach of any telescope in the world. The distance, according to my measures in 1890, was 4″.19. It seems hardly possible that it could have been wholly invisible this year under the conditions named, if the diminution in the distance is only 0″.7, as it should be, according to the orbits of GORE and HOWARD. I have therefore concluded that the small star is approaching *Sirius* more rapidly, and that the change in distance must be decidedly larger, and certainly not less than 1″, and consequently have drawn the shorter ellipse as more likely to represent the real motion. According to this, the distance at the time of my last attempts to see the companion was 3″.1, and it is not at all improbable that, at this distance from a star as bright as *Sirius*, it would be lost in the overpowering brilliancy of the large star, even with the LICK telescope. For these reasons I think a period of fifty-three years is not likely to be too short.

If this ellipse is correct the minimum distance will be 2″.4 in 1892.5, and about the end of 1894 the distance will be the same as at the time of my last measures. At that time, therefore, I trust the large telescope will supply observations which will definitely settle most of the uncertainties in the orbit of this interesting system.

Lick Observatory, Feb. 26, 1891.

[Since the foregoing was written, Dr. AUWERS has made an exhaustive investigation of the *Sirius* system, which will be found in A.N. 129.]

β 756.

R. A. $6^h\ 41^m\ 0^s$
Decl. $+\ 39^\circ\ 35'$

1890.785 No double found in or near this place with the 36-inch.

The star was suspected to be a close pair with the 6-inch.

β 897.

R. A. $6^h\ 44^m\ 42^s$
Decl. $-\ 0^\circ\ 23'$

	°	″		
1891.903	30.8	6.15	6.0 . . 11.8	36
.958	32.7	5.66	6.5 . . 11.5	36
1892.036	32.5	6.18	6.0 . . 11.0	36
1892.00	32.0	6.00	6.2 . . 11.4	

These measures show that the proper motion is common to both stars.

β 898.

R. A. $6^h\ 45^m\ 0^s$
Decl. $-\ 15^\circ\ 53'$

A and B.

	°	″		
1891.958	356.8	3.01	8.0 . . 10.0	36
1892.036	358.7	3.39	8.0 . . 9.3	36
.055	357.1	3.28	8.0 . . 9.3	36
1892.00	357.5	3.23	8.0 . . 9.5	

C and D.

	°	″		
1891.958	269.9	1.65	9.0 . . 9.2	36
1892.036	271.1	2.03	9.3 . . 9.4	36
.055	269.9	2.05	9.0 . . 9.2	36
1892.00	270.3	1.91	9.1 . . 9.3	

A and C.

1891.958	282°.1	96".57	... 36
1892.036	282.0	96.48	... 36
.055	282.2	97.27	... 36
1892.00	282.1	96.77	...

No evidence of change.

β 899.

R. A. 6h 52m 9s
Decl. + 18° 53′

A and B.

1892.115	267°.8	0".59	9.0 .. 10.0	36
.153	268.2	0.58	8.5 .. 8.7	36
1892.13	268.0	0.58	8.7 .. 9.3	

AB and C.

1892.115	175°.3	24".32	.. 10.0	36
.153	175.2	24.34	.. 10.0	36
1892.13	175.5	24.33	.. 10.0	

AB and D.

1892.115	48°.0	40".44	... 9.0	36
.153	47.7	40.48	... 9.0	36
1892.13	47.8	40.46	... 9.0	

β 327.

R. A. 6h 52m 28s
Decl. — 2° 52′

A and B.

1892.085	93°.9	0".74	8.0 ... 8.1	36
.088	97.1	0.80	8.5 ... 8.5	36
.115	96.3	0.82	8.0 ... 8.0	36
1892.08	95.8	0.79	8.2 ... 8.2	

AB and C.

1892.088	100°.2	13".20	.. 11.5	36
.115	99.7	12.99	.. 11.8	36
1892.10	100.0	13.10	.. 11.6	

β 572.

R. A. 6h 55m 44s
Decl. — 20° 30′

1892.085	142°.5	5".02	7.0 .. 11.0	36
.115	142.4	5.59	6.7 .. 11.0	36
.153	142.8	5.19	7.0 .. 11.0	36
1892.12	142.6	5.27	6.9 .. 11.0	

β 900.

R. A. 6h 58m 33s
Decl. + 21° 11′

1892.173	276°.2	1".73	8.0 .. 12.0	36
.192	271.8	1.71	8.0 .. 11.5	36
.263	271.1	1.66	8.0 .. 11.0	36
1892.21	273.0	1.70	8.0 .. 11.5	

β 328.

R. A. 7h 1m 3s
Decl. — 11° 7′

A and B.

1891.903	115°.8	0".46	6.5 ... 7.5	36
1892.184	114.8	0.59	6.8 ... 7.5	12
.186	121.3	0.48	6.0 ... 7.5	36
.189	120.3	0.51	6.0 ... 8.0	36
1892.11	118.0	0.51	6.3 ... 7.6	

AB and C (= Σ 1026 rej.).

1891.903	349°.8	17".38	.. 10.3	36
1892.115	348.8	17.47	.. 10.5	36
.153	348.1	17.51	.. 10.5	36
1892.04	348.9	17.45	.. 10.4	

β 574.

R. A. 7h 1m 18s
Decl. — 11° 8′

1891.903	310°.4	2".29	8.0 .. 11.0	36
1892.115	310.0	2.15	8.0 .. 11.5	36
.153	313.4	2.35	8.3 .. 11.7	36
1892.04	311.3	2.26	8.1 .. 11.4	

0Σ 165. 45 Geminorum.

R. A. 7h 1m 29s
Decl. + 16° 9′

1890.939	54°.0	3".29	6.0 .. 13.0	36
.955	51.5	3.35	6.0 .. 12.0	36
.974	53.5	3.12	6.0 .. 12.5	36
1890.96	53.0	3.25	6.0 .. 12.5	

The change in this pair is due to proper motion. The apparent motion of B is about 0".1 per annum in the direction of 358°.4.

β 1009. τ Geminorum.

R. A. $7^h\ 3^m\ 30^s$
Decl. $+\ 30°\ 26'$

	°	″		
1890.903	177.0	1.75	4.5 . . 12.5	36
.939	180.9	1.94	. . 14.0	36
.955	173.9	1.51	. . 13.5	36
1891.052	178.6	1.79	. . 13.0	36
1890.96	177.6	1.75	. . 13.2	

There has been no material change in this pair since my measures in 1882.

β 329. Canis Majoris 146.

R. A. $7^h\ 4^m\ 8^s$
Decl. $-\ 16°\ 2'$

	°	″		
1892.036	96.7	29.51	6.5 . . 11.5	36
.153	96.8	30.00	6.0 . . 11.5	36
.173	96.9	30.02	6.0 . . 11.5	36
1892.12	96.8	29.84	6.2 . . 11.5	

β 1023.

R. A. $7^h\ 7^m\ 45^s$
Decl. $+\ 26°\ 5'$

	°	″		
1891.225	292.2	0.29	8.5 . . . 8.6	36
.227	295.9	0.26	8.5 . . . 8.5	36
.246	293.8	0.20	8.3 . . . 8.3	36
1891.23	294.0	0.25	8.4 . . . 8.5	

No other measures.

β 901. 65 Aurigae.

R. A. $7^h\ 14^m\ 2^s$
Decl. $+\ 36°\ 59'$

	°	″		
1891.091	9.0	11.29	6.0 . . 11.5	36
.225	9.6	10.96	. . 11.0	36
.227	8.8	11.16	. . 12.0	36
1891.18	9.1	11.14	. . 11.5	

OΣ 171.

R. A. $7^h\ 18^m\ 53^s$
Decl. $+\ 31°\ 52'$

	°	″		
1890.890	130.0	1.16	7.5 . . 9.0	36
.903	130.4	1.19	7.8 . . 10.5	36
.936	132.4	1.04	8.0 . . 9.5	36
1890.91	130.9	1.13	7.8 . . 9.7	

There is very little, if any, change in this pair since the first measures.

β 577.

R. A. $7^h\ 14^m\ 21^s$
Decl. $+\ 0°\ 38'$

A and B (= Σ 1074).

	°	″		
1892.184	140.0	0.50	8.3 . . . 8.5	12
.186	142.8	0.54	. . .	36
.192	145.3	0.60	8.0 . . . 8.1	36
1892.18	142.7	0.55	8.1 . . . 8.3	

AB and C.

	°	″		
1892.186	100.0	12.80	. . 13.5	36
.192	100.0	12.71	. . 13.5	36
1892.19	100.0	12.75	. . 13.5	

AB and D.

	°	″		
1892.186	10.0	15.27	. . 13.0	36
.192	11.3	15.35	. . 13.0	36
1892.19	10.6	15.31	. . 13.0	

AB and E.

	°	″		
1892.184	277.5	53.25	. . 11.0	12
.186	278.2	53.78	. . 10.5	36
.192	278.4	53.84	. . 10.8	36
1892.18	278.0	53.62	. . 10.8	

The close pair is a binary in slow motion.

β 1024.

R. A. $7^h\ 15^m\ 33^s$
Decl. $+\ 29°\ 32'$

	°	″		
1892.263	103.2	1.40	9.0 . . 11.5	36

No other measures.

β 758. Lyncis 51.

R. A. $7^h\ 20^m\ 0^s$
Decl. $+\ 48°\ 26'$

	°	″		
1892.055	92.9	16.91	6.0 . . 11.5	36
.184	93.5	16.44	6.0 . . 11.3	12
.197	93.0	16.34	6.0 . . 10.5	12
1892.14	93.1	16.56	6.0 . . 11.1	

β 21. η Canis Minoris.

R. A. $7^h\ 21^m\ 35^s$
Decl. $+\ 7°\ 11'$

	°	″		
1891.903	26.5	4.01	5.0 . . 11.5	36
.969	25.0	3.91	6.0 . . 11.0	36
1892.022	25.8	4.04	6.0 . . 11.0	36
1891.96	25.8	3.99	5.7 . . 11.2	

β 332.

R. A. $7^h\ 22^m\ 14^s$
Decl. $-11^\circ\ 19'$

A and B.

1892.022	168°.9	0".69	6.5 . . . 8.0	36
.036	169.3	0.89	7.0 . . . 8.0	36
.055	168.0	0.97	7.0 . . . 8.3	36
1892.04	168.7	0.85	6.8 . . . 8.1	

AB and C (= Σ 1097).

1892.022	312°.2	19".96	. . . 9.0	36
.036	313.3	19.80	. . . 9.0	36
.055	312.7	19.87	. . . 9.0	36
1892.04	312.7	19.88	. . . 9.0	

AB and D.

1892.055	157°.7	23".41	. . 11.3	36
.153	157.9	23.23	. . 10.8	36
1892.10	157.8	23.32	. . 11.0	

AB and E.

1892.055	42°.7	32".20	. . 12.0	36
.153	42.9	32.23	. . 11.5	36
1892.10	42.8	32.21	. . 11.7	

Very little change in any of the components.

β 22.

R. A. $7^h\ 25^m\ 30^s$
Decl. $+33^\circ\ 7'$

1890.898	150°.5	6".46	8.3 . . 9.5	36
.903	150.3	6.55	8.0 . . 10.0	36
.936	150.3	6.24	8.5 . . 10.5	36
1890.91	150.4	6.42	8.3 . . 10.0	

No change in this pair.

β 579.

R. A. $7^h\ 26^m\ 40^s$
Decl. $+33^\circ\ 23'$

1890.890	213°.7	0".86	8.0 . . 10.0	36
.898	214.3	0.83	7.7 . . 9.5	36
.903	213.8	1.01	8.0 . . 10.5	36
1890.90	213.9	0.90	7.9 . . 10.0	

The only other measure of this is:

1878.24	219°.1	0".84	β	1 n

The principal star and two distant companions make OΣ 173. The close star was discovered with the 6-inch.

β 200. 70 Geminorum.

R. A. $7^h\ 30^m\ 41^s$
Decl. $+35^\circ\ 19'$

C and D.

1891.969	240°.7	1".83	9.0 . . 10.0	36
1892.057	241.9	1.64	9.3 . . 9.7	36
.151	244.1	1.75	9.5 . . 10.5	36
1892.06	242.2	1.74	9.3 . . 10.1	

A and B (= *H V.* 70).

1891.969	190°.2	98".92	. . 10.5	36
1892.112	189.7	98.96	. . 10.0	12
1892.04	190.0	98.94	. . 10.2	

A and C.

1891.969	98°.9	161".08	. .	36
1892.112	98.2	161.85	. . 9.0	12
1892.04	98.5	161.46		

C and E.

1892.057	203°.0	17".70	. . 13.5	36
.151	203.7	17.27	. . 13.5	36
1892.10	203.3	17.48	. . 13.5	

Procyon.

R. A. $7^h\ 33^m\ 1^s$
Decl. $+5^\circ\ 33'$

1888.818. Carefully examined with all powers up to 3300 on the 36-inch under favorable conditions. Large star single, and no near companion.

1890.785 Carefully examined with various powers. Nothing nearer than the old companion.

β 580. Pollux.

R. A. $7^h\ 38^m\ 1^s$
Decl. $+28^\circ\ 19'$

A and B.

1892.057	277°.4	33".91	. . 14.5	36
.170	277.4	34.34	. . 14.5	36
.192	278.9	34.05	. . 14.0	36
1892.14	277.9	34.10	. . 14.3	

C and D.

1889.142	130.9	1.14	9.5 . . 12.5	36
1892.057	129.7	1.19	10.0 . . 12.0	36
.170	130.0	1.10	10.5 . . 12.0	36
.192	130.6	1.12	9.5 . . 11.5	36
1892.14	130.6	1.14	10.0 . . 11.8	

Σ 1143.

R. A. $7^h\ 41^m\ 41^s$
Decl. $+\ 5^\circ\ 42'$

This is one of the missing pairs of Σ. As it could not be found by STRUVE himself, it is hardly worth while further attempting to recover it. It is evidently in some other part of the sky. I examined all the stars in this vicinity with the 36-inch, and there is certainly no pair here answering STRUVE'S description.

β 101. 9 Argus.

R. A. $7^h\ 46^m\ 13^s$
Decl. $-\ 13^\circ\ 35'$

1889.049	81.2	0.28	6.0 . . . 6.4	36
.077	75.6	0.34	6.0 . . . 6.5	36
.091	72.2	0.35	5.5 . . . 6.0	36
.093	76.6	0.39	5.5 . . . 6.3	36
1889.08	76.4	0.34	5.7 . . . 6.3	
1890.249	88.3	0.28	. . .	36
.252	84.8	0.29	. . .	36
.255	83.0	0.31	. . .	36
.269	82.4	0.34	. . .	36
1890.26	84.6	0.31	. . .	
1890.903	89.6	0.34	5.5 . . . 6.5	36
.939	82.9	0.44	6.0 . . . 6.0	36
1891.052	92.4	0.31	6.0 . . . 6.4	36
1890.96	88.3	0.36	. . .	
1891.903	99.1	0.23	. . .	36
1892.057	96.1	0.28	. . .	36
.186	100.8	0.15	. . .	36
1892.05	98.7	0.22	. . .	

This pair, which was discovered with the 6-inch in 1873, is certainly a binary in rapid motion. Some of the measures are:

1875.71	289.4	0.46	Δ	3 n
1878.52	301.8	0.46	β	3 n
1880.12	315.1	0.34	Hl	1 n
1883.11	336.2	0.3±	β	1 n
1888.26	356.1	0.29	Sp	5 n

Prof. GLASENAPP has recently computed the orbit of this binary (*Monthly Notices*, June, 1892), using my latest measures, and finds a period of 40.54 years. I am inclined to think that the final period may be much less. It is now a very difficult pair.

OΣ 185.

R. A. $7^h\ 51^m\ 7^s$
Decl. $+\ 1^\circ\ 27'$

1890.903	8.1	0.20	6.8 . . . 6.9	36
.939	3.6	0.21	6.8 . . . 7.2	36
1891.052	6.2	0.24	7.0 . . . 7.2	36
1890.96	6.0	0.22	6.9 . . . 7.1	
1892.186	11.8	0.25	. . .	36
.189	7.9	0.24	. . .	36
.192	8.4	0.27	. . .	36
1892.18	9.4	0.25	. . .	

There are very few measures of this pair. It has generally been noted as single, or doubtful. It may be in rapid motion, but the measures are insufficient to decide.

β 23.

R. A. $7^h\ 56^m\ 14^s$
Decl. $+\ 3^\circ\ 25'$

1891.903	183.1	2.67	8.0 . . 11.5	36
.958	179.7	2.57	8.0 . . 10.0	36
1892.055	183.0	2.61	8.0 . . 11.0	36
1891.97	181.9	2.62	8.0 . . 10.8	

β 202.

R. A. $7^h\ 56^m\ 59^s$
Decl. $-\ 26^\circ\ 53'$

1891.958	160.2	7.95	7.0 . . 9.5	36
1892.173	160.0	7.36	7.0 . . 10.0	36
.178	162.0	8.00	7.5 . . 10.5	12
1892.10	160.7	7.77	7.2 . . 10.0	

β 581.

R. A. $7^h\ 57^m\ 44^s$
Decl. $+\ 12^\circ\ 38'$

A and B.

1891.903	262.2	0.45	8.3 . . . 8.3	36
.906	260.5	0.57	8.5 . . . 8.5	36
1892.022	257.0	0.28	8.5 . . . 8.7	36
.055	258.1	0.55	8.5 . . . 8.6	36
1891.97	259.4	0.46	8.5 . . . 8.6	

AB and C.

	°	″		
1891.903	193.7	4.71	. . 11.0	36
.906	193.1	4.42	. . 11.0	36
1892.022	192.0	4.66	. . 12.5	36
.055	191.9	4.62	. . 11.5	36
1891.97	192.7	4.60	. . 11.5	

This fine triple star was discovered in 1878 with the 18½-inch refractor of the Dearborn Observatory. As the close pair was o″.4 in distance, it was readily measurable with that instrument, and with a moderately close third star it was an interesting object on the telescope, visually at least. About the same time it was measured by DEMBOWSKI, and a few years later by ENGELMANN, so that we have good positions for the components at that time. I have recently looked it up, and made a set of measures with the 36-inch refractor of this Observatory. Since these last measures were made I have received from SCHIAPARELLI two sets of measures, which fill an important place in the intervening period.

The following are all the measures of both components to this time:

A and B.

	°	″		
1878.15	176.9	0.40	β	2 n
1878.22	180.3	0.40	△	1 n
1883.37	205.2	0.30	En	5 n
1889.23	249.8	0.40	Sp	4 n
1890.21	253.7	0.50	Sp	4 n
1891.97	259.4	0.46	β	4 n

AB and C.

	°	″		
1878.13	185.3	4.76	β	3 n
1878.22	184.3	4.76	△	1 n
1891.97	192.7	4.60	β	4 n

Some of the angles of the close pair are reversed, but I have placed them all on the same side, since this gives nearly uniform motion during the whole time. As there is no material change in the distance, there can be no doubt that this is the proper disposition of the angles, making the total motion during this time 82° instead of 262°. The components are so nearly equal that the 36-inch shows but little difference in magnitude.

There is a remarkable similarity between this triple system and that of ζ *Cancri*. The close pair of the latter has a period of about fifty-eight years. In this star the motion of AB since 1878 has been at the rate of 6° per year. On the assumption of uniform motion, this would give almost exactly the same periodic time. The third star, C, is about the same distance from AB in each case. In ζ *Cancri* the annual motion is about half a degree in a retrograde direction; while in β 581 the movement is direct, and about the same in amount. Of course, the latter is a much more difficult triple than ζ *Cancri*, and will require a much larger aperture.

β 582.

R. A. 7ʰ 58ᵐ 6ˢ
Decl. + 12° 25′

B and C.

	°	″		
1891.903	57.6	3.94	8.6 . . 10.5	36
1892.022	56.7	3.88	9.0 . . 13.0	36
.055	58.4	3.98	8.5 . . 11.0	36
1891.99	57.6	3.93	8.7 . . 11.5	

A and B (= Σ 1179).

	°	″		
1891.903	204.2	20.09	. . . 8.6	36
1892.022	204.7	19.63	. . . 9.0	36
.055	203.8	20.06	. . . 8.5	36
1891.99	204.2	19.93	. . . 8.7	

No material change in BC. STRUVE made the distance of AB 17″.91 in 1829.

β 903.

R. A. 7ʰ 58ᵐ 9ˢ
Decl. — 1° 31′

	°	″		
1892.022	32.0	1.62	8.5 . . . 9.2	36
.153	33.6	1.45	8.2 . . . 8.8	36
.173	32.9	1.55	8.0 . . . 9.0	36
1892.11	32.8	1.54	8.2 . . . 9.0	

No sensible motion.

β 583.

R. A. 8ʰ 3ᵐ 18ˢ
Decl. — 6° 21′

	°	″		
1892.022	70.0	1.71	9.0 . . . 9.1	36
.153	68.1	1.68	9.0 . . . 9.1	36
.173	70.4	1.72	8.7 . . . 9.0	36
1892.11	69.5	1.70	8.9 . . . 9.1	

No evidence of change.

Σ 1196. ζ Cancri.

R. A. $8^h\ 5^m\ 20^s$
Decl. $+\ 18^\circ\ 1'$

1889.285, .296 Examined under fairly good conditions with powers up to 1500 or more, and no other component or near star seen.

1890.939 All the stars round, with powers up to 1500.

A and C.

1891.181	117°.6	5".45	...	12
.214	117.2	5.49	...	12
.222	115.9	5.42	...	12
.225	117.3	5.57	...	36
.227	116.2	5.58	...	36
.239	115.5	5.52	...	36
1891.22	116.6	5.50	...	
1892.057	115.3	5.51	...	36
.153	116.5	5.41	...	36
.156	117.7	5.42	...	36
.186	117.3	5.58	...	36
1892.14	116.7	5.48	...	

B and C.

1891.181	128°.1	5".52	...	12
.214	127.6	5.66	...	12
.222	128.5	5.56	...	12
.225	127.4	5.58	...	36
.227	127.7	5.61	...	36
.239	127.3	5.69	...	36
1891.22	127.8	5.60	...	
1892.057	127.4	5.66	...	36
.153	128.3	5.48	...	36
.156	127.6	5.52	...	36
.186	127.5	5.46	...	36
1892.14	127.7	5.53	...	

A and B.

1892.153	32°.7	1".04	...	36
.186	33.2	1.02	...	36
1892.17	33.0	1.03	...	

C and Lalande 12262.

1891.225	Dif. Decl. =	103".89	...	36
.227		104.05	...	36
.239		104.08	...	12
.241		103.99	...	36
1892.057	Dif. Decl. =	103".80	7:35	36
.085		103.72	8:00	36
.118		103.97	8:25	36
.153		103.99	8:00	36
.156		103.87	8:15	36

C and D.M. (18°) 1870.

1891.181	P =	108°.17	...	12
.208		108.33	...	12
.214		108.14	...	12
.222		108.32	...	12
.225		108.28	...	36
.227		108.15	...	36
.239		108.31	...	36
.241		108.17	...	36
1892.057		107.90	7:30	36
.156		108.25	8:00	36
.173		108.50	6:25	36
.186		108.35	8:10	36

The distant stars were measured for the purpose of determining hereafter whether the apparent variable movement of C about AB is due to errors of observation in connecting it with the close pair, or to the existence of a fourth "dark star" hitherto unseen. An examination of the measures which form the basis of the theory of an invisible disturbing body will be found in a paper by the writer in *Monthly Notices* for April, 1891.

The mean results are:

C and Lalande 12262.

1891.23	Dif. Decl. =	104".00	...	4 n
1892.11		103.87	...	5 n

C and D.M. (18°) 1870.

1891.22	P =	108°.23	...	8 n
1892.14		108.00	...	4 n

β 454.

R. A. $8^h\ 10^m\ 12^s$
Decl. $-\ 30^\circ\ 23'$

1892.184	16°.7	2".33	8.3 ..	9.5	12
.197	15.8	2.49	8.0 ..	10.0	12
.227	16.3	2.41	8.0 ..	8.7	36
1892.20	16.3	2.41	8.1 ..	9.4	

No other measures.

β 102.

R. A. 8h 11m 0s
Decl. — 8° 38′

1892.022	118°.1	3″.37	7.0 . . 10.0	36
.057	123.2	3.26	7.8 . . 10.0	36
.153	121.2	3.26	7.4 . . 10.0	36
1892.08	120.8	3.30	7.4 . . 10.0	

No change since 1875.

β 1067. o Ursae Majoris.

R. A. 8h 20m 17s
Decl. + 61° 7′

1892.060 No trace of the companion. Fine seeing.

.189 Splendid seeing. Companion not seen with any certainty.

This was discovered with the 36-inch in 1889. My three observations gave:

1889.22	191°.4	7″.01	15.2

I cannot explain the failure to see the companion now.

β 205.

R. A. 8h 27m 54s
Decl. — 24° 12′

1890.274	82°.2	0″.65	7.5 . . . 7.5	36
.282	81.6	0.75	. . .	36
1890.28	81.9	0.70	. . .	
1891.244	257.1	0.63	7.0 . . . 7.4	36
1892.156	255.9	0.70	6.8 . . . 7.0	36
.227	255.5	0.63	7.8 . . . 8.0	36
1891.87	256.2	0.65	7.2 . . . 7.5	

Retrograde motion. The angles in the following measures are changed, when necessary, to the same side:

1874.19	130°.±	0″.7±	β	
1878.53	100.3	0.63	Cin_5	3 n
1882.21	96.6	0.5±	Sp	3 n
1886.17	90.1	0.80	Wilson	2 n

β 584.

R. A. 8h 32m 58s
Decl. + 19° 58′

A and B.

1891.969	294°.1	1″.37	8.0 . . 11.0	36
1892.022	290.7	1.10	8.0 . . 11.0	36
.151	292.4	1.31	8.0 . . 13.0	36
1892.05	292.4	1.26	8.0 . . 11.7	

A and C (= *S* 571).

1891.969	156°.1	44″.72	. . . 8.0	36
1892.022	156.6	44.60	. . . 7.8	36
.151	156.0	45.07	. . . 8.0	36
1892.05	156.2	44.80	. . . 7.9	

Without material change.

β 208.

R. A. 8h 33m 54s
Decl. — 22° 16′

1889.131	44°.9	1″.08	. . .	36
.173	50.1	1.05	7.0 . . . 8.0	12
1889.15	47.5	1.06	7.0 . . . 8.0	
1892.057	52.1	0.71	7.0 . . . 8.3	36
.156	51.9	0.71	6.5 . . . 8.0	36
.227	52.9	0.68	7.0 . . . 8.0	36
1892.11	52.3	0.70	6.8 . . . 8.1	

There would seem to be no doubt of change in this pair from the following:

1874.20	30°.4	1″.4±	β	1 n
1878.43	33.9	1.37	Cin_5	5 n
1882.21	40.9	1.21	Sp	3 n
1889.15	47.5	1.06	β	2 n

ε Hydrae.

R. A. 8h 40m 25s
Decl. + 6° 52′

A and B.

1888.818	151°.0	0″.27	4.0 . . . 6.0	36
1889.151	157.9	0.25	4.0 . . . 6.0	36
1888.98	154.4	0.26	4.0 . . . 6.0	
1890.903	171.8	0.21	3.5 . . . 5.5	36
.939	168.3	0.17	3.5 . . . 6.0	36
1890.92	170.0	0.19	. . .	

1892.186	180°.4	0".23	...7.0	36
.189	178.8	0.19	...7.8	36
1892.18	179.6	0.21	...	

AB and C (Σ 1273).

1888.818	226°.5	3".11	...	36
1889.151	225.6	3.16	...	36
.288	227.3	3.22	...	36
1889.08	226.5	3.16	...	

AB and D.

1889.151	193°.5	19".71	..13.0	36
.288	194.1	19.66	..	36
1889.22	193.8	19.68	..13.0	

The duplicity of the principal star was detected by SCHIAPARELLI in 1888, but an apparent elongation had been noted by *OΣ* in 1860. It is a difficult pair, and will certainly prove to be a ternary system. The motion of C has been about 31° since 1830.

The distant companion was detected with the Washington 26-inch.

1888.28	142°.0	0".21	Sp	6 n	A and B
1878.60	192.0	20.05	β	2 n	AB and D

β 335.

R. A. 8h 41m 58s
Decl. + 3° 2′

1892.022	268°.4	2".63	7.5..11.0	36
.055	270.2	2.53	7.5..10.0	36
.115	271.7	2.59	7.0..11.0	36
1892.06	270.1	2.58	7.3..10.7	

Perrotin. D.M. (8°) 2132.

R. A. 8h 44m 49s
Decl. + 8° 47′

1889.107	351°.0	0".97	8.0...8.7	36
.115	348.9	1.01	7.8...8.5	36
.131	350.4	0.88	8.0...8.7	36
1889.12	350.1	0.95	7.9...8.6	

Discovered by PERROTIN, and stated to be in the vicinity of *OΣ* 195, but no place is given. I wished to identify the star and find its position, and in doing that, made the measures given. The magnitude in DM. is 8.2. The only other measures are:

1884.20	349°.3	0".78	7.5..8.7	Per	2 n

β 587. 15 Hydrae.

R. A. 8h 45m 41s
Decl. — 6° 44′

A and B.

1892.055	153°.1	0".61	6.0...8.5	36
.057	156.6	0.68	7.0...8.5	36
.189	145.9	0.47	6.0...7.5	36
1892.10	151.9	0.59	6.3...8.2	

AB and C (= *H V.* 120).

1892.055	357°.3	45".35	..11.0	36
.057	357.3	45.36	..10.3	36
1892.06	357.3	45.35	..10.6	

AB and D.

1892.055	53°.1	50".26	..11.5	36
.057	53.3	50.23	..11.0	36
1892.06	53.2	50.24	..11.2	

The angle of the close pair is diminishing.

κ Cancri.

R. A. 9h 1m 0s
Decl. + 11° 10′

1889.131 This star was examined for the reason that DAWES and others noticed a gradual disappearance when occulted by the moon. I could see no sign of duplicity.

β 410.

R. A. 9h 4m 30s
Decl. — 25° 19′

1892.197	159°.0	1".65	8.0...9.0	36
.230	160.8	1.66	6.8...7.8	36
.299	163.8	1.70	8.0...9.0	12
1892.24	161.2	1.67	7.6...8.6	

Without change.

β 104.

R. A. 9h 5m 19s
Decl. + 0° 47′

1892.055	106°.3	2".83	7.0..11.0	36
.173	106.3	2.74	7.0..11.0	36
.175	107.9	3.08	7.0..11.0	36
1892.13	106.8	2.88	7.0..11.0	

Change uncertain.

β 908.

R. A. $9^h\ 8^m\ 25^s$
Decl. $-\ 7^\circ\ 48'$

B and C.

1892.186	233°.3	0".78	9.0 . . 10.5	36
.230	228.2	0.70	9.5 . . 10.7	36
1892.21	230.7	0.74	9.2 . . 10.6	

A and B.

1892.186	184°.5	60".46	8.8 . . .	36
.230	184.5	60.71	8.5 . . .	36
1892.21	184.5	60.58	8.6 . . .	

Σ 1321.

R. A. $9^h\ 6^m\ 23^s$
Decl. $+\ 53^\circ\ 13'$

1891.091	62°.5	19".50	7.5 . . . 7.5	36
.118	62.7	19.36	. . .	12
.134	62.1	19.40	. . .	12
1891.11	62.4	19.42	. . .	

The change in the components is due to a slight difference in their proper motion. The system is like that of 61 *Cygni*. (See paper by the present writer in *Sidereal Messenger* for April, 1891.)

β 588.

R. A. $9^h\ 10^m\ 30^s$
Decl. $+\ 1^\circ\ 14'$

1892.022	123°.7	2".40	7.0 . . 11.5	36
.055	125.8	2.60	6.8 . . 11.0	36
.057	125.8	2.35	7.5 . . 11.0	36
1892.05	125.1	2.45	7.1 . . 11.2	

Σ 3121.

R. A. $9^h\ 10^m\ 46^s$
Decl. $+\ 29^\circ\ 5'$

1891.225	347°.3	0".31	. . .	36
.227	344.5	0.25	. . .	36
.246	343.3	0.32	. . .	36
1891.23	345.0	0.29	. . .	

β 105. κ Leonis.

R. A. $9^h\ 17^m\ 40^s$
Decl. $+\ 26^\circ\ 42'$

1889.107	204°.3	2".83	4½ . . 11.0	36
.134	201.6	2.71	. . 10.8	36
.151	205.8	2.83	. . 11.0	36
1889.13	203.9	2.79	. . 10.9	

ENGELMANN speaks of a 10" star in the direction of 65°. There is certainly no companion in this place, and no third star near in any direction. A difficult pair of small stars about 5' nf is given in the list of new doubles.

There seems to be no change in κ *Leonis*.

1876.10	203°.8	3".05	⊿	5 n
1883.47	205.1	3.36	En	8 n

β 589.

R. A. $9^h\ 20^m\ 15^s$
Decl. $+\ 7^\circ\ 3'$

1892.055	219°.4	3".12	7.0 . . 11.5	36
.057	219.5	3.09	8.0 . . 11.0	36
.115	217.9	3.17	7.4 . . 11.0	36
1892.06	218.9	3.13	7.5 . . 11.2	

Change doubtful.

β 213.

R. A. $9^h\ 22^m\ 25^s$
Decl. $-\ 7^\circ\ 34'$

1892.055	178°.9	1".74	8.0 . . . 9.3	36
.057	180.3	1.58	8.0 . . . 9.3	36
.173	179.3	1.53	8.0 . . . 9.5	36
1892.09	179.5	1.62	8.0 . . . 9.4	

β 590. 29 Hydrae.

R. A. $9^h\ 21^m\ 22^s$
Decl. $-\ 8^\circ\ 42'$

1891.246	175°.1	11".09	6.0 . . 11.0	36
.301	177.0	10.81	6.0 . . 11.0	36
1891.27	176.0	10.95	6.0 . . 11.0	

Probably fixed.

β 591.

R. A. $9^h\ 23^m\ 33^s$
Decl. $-\ 2^\circ\ 36'$

1892.022	34.8	0.64	8.0 . . . 9.0	36
.057	34.5	0.75	8.0 . . . 8.7	36
.184	36.8	0.76	8.0 . . . 8.5	12
1892.08	35.4	0.72	8.0 . . . 8.7	

No certain change.

β 909.

R. A. $9^h\ 25^m\ 25^s$
Decl. $+\ 22^\circ\ 24'$

1892.115	90.4	6.07	7.0 . . 11.2	36
.184	92.9	5.48	8.0 . . 13.0	12
.230	89.9	6.28	7.0 . . 11.8	36
1892.17	91.1	5.94	7.3 . . 12.0	

Without change.

Jacob 5. Lac. 3873.

R. A. $9^h\ 25^m\ 26^s$
Decl. $-\ 28^\circ\ 14'$

1889.115	248.0	1.16	6.0 . . . 7.0	36
.296	241.4	1.25	7.0 . . . 7.3	36
.312	245.1	0.74	6.0 . . . 7.0	36
1889.24	244.8	1.05	6.3 . . . 7.1	

Discovered by JACOB during an occultation by the moon. Change is doubtful from the two previous measures.

1858.1	244.6	0.55	J	1 n
1878.53	235.5	0.58	Cin_5	2 n

β 1071. θ Ursae Majoris.

R. A. $9^h\ 25^m\ 50^s$
Decl. $+\ 52^\circ\ 11'$

1890.356	78.1	5.11	. . 13.5	36
.375	80.2	4.62	. .	36
.422	79.0	4.88	. .	36
1890.38	79.1	4.87	. .	
1892.036	72.3	5.00	3.0 . . 14.0	36
.057	78.5	5.24	. . 14.0	36
.060	75.0	5.20	. . 14.5	36
1892.05	75.3	5.15	. . 14.2	

It is evident that the companion has the same proper motion as the large star. The first measures were:

1889.23	74.9	5.09	β	3 n

The bright star has a proper motion of 1".12 in the direction of 240°. The stars are certainly physically connected.

β 910.

R. A. $9^h\ 27^m\ 10^s$
Decl. $-\ 13^\circ\ 28'$

1892.055	306.1	6.82	7.0 . . 10.5	36
.057	305.7	6.39	7.8 . . 11.0	36
.115	306.0	6.84	7.0 . . 10.5	36
1892.06	305.9	6.68	7.3 . . 10.7	

Unchanged.

OΣ 521. τ Ursae Majoris.

R. A. $9^h\ 42^m\ 30^s$
Decl. $+\ 59^\circ\ 36'$

1889.151	294.9	11.34	5.0 . . 13.0	36
.159	293.3	11.11	. . 13.0	36
.247	295.3	11.24	. . 11.5	36
1889.18	294.5	11.23	. . 12.5	
1892.060	295.1	11.45	4.0 . . 13.5	36
.151	294.1	11.27	. . 12.0	36
.186	297.3	11.38	. . 13.0	36
1892.13	295.5	11.37	. . 12.8	

There is no relative motion, but the two stars must belong to the same system, since they have the same considerable proper motion of 0".34 in the direction of 233°.7. The following are the only other measures I have found:

1858.58	295.3	11.32	OΣ	7 n

OΣ 208. Φ Ursae Majoris.

R. A. $9^h\ 43^m\ 56^s$
Decl. $+\ 54^\circ\ 38'$

1892.060	249.6	0.29	5.5 . . . 5.5	36
.186	252.0	0.21	5.5 . . . 5.5	36
.189	250.9	0.21	. . .	36
1892.13	250.8	0.24	5.5 . . . 5.5	

A.C. 5. 8 Sextantis.

R. A. $9^h\ 46^m\ 34^s$
Decl. $-\ 7^\circ\ 32'$

1889.091	121.5	0.44	5.5 . . . 6.0	36
.131	128.0	0.45	5½ . . . 6.0	36
.296	127.2	0.72	. . .	36
1889.17	125.6	0.54	5½ . . . 6.0	

1890.252	114.6	0.25	. . .	36
.269	113.9	0.36	. . .	36
.280	111.2	0.30	. . .	36
.301	116.8	0.39	. . .	36
1890.27	114.1	0.32	. . .	
1891.052	114.2	0.28	. . .	36
.225	109.4	0.38	. . .	36
.227	114.0	0.31	. . .	36
.244	114.9	0.30	. . .	36
1891.17	113.1	0.32	. . .	
1892.118	106.0	0.36	. . .	36
.153	106.1	0.39	. . .	36
.170	107.2	0.47	. . .	36
.186	102.1	0.42	. . .	36
1892.17	105.3	0.41	. . .	

An interesting binary, of which there are too few measures. It was discovered by Mr. CLARK in 1852 with a telescope of only 4¾-inch aperture. I found it apparently single with 18½-inch in 1879–81.

1854.22	50.5	0.5 ±	Da	1 n
1875.30	169.0	—	Δ	4 n
1878.22	117.4	0.2 ±	Cin	2 n
1878.26	161 ±	0.25 ±	β	2 n

GLASENAPP has recently computed the orbit, using my last measures, and finds a period of 93.92 years.

β 218.

R. A. 10h 1m 41s
Decl. — 19° 7′

1892.055	122.0	0.85	8.0 . . . 8.1	36
.186	126.8	0.98	8.0 . . . 8.0	36
.189	124.5	0.89	8.0 . . . 8.1	36
1892.14	124.4	0.91	8.0 . . . 8.1	

Regulus.

R. A. 10h 2m 0s
Decl. + 12° 33′

B and C.

1890.255	86.0	3.01	. .	36
.269	86.8	3.36	. .	36
.282	84.2	2.78	. .	36
1890.27	85.7	3.05	. .	
1891.326	87.0	3.11	9.0 . . 13.0	36
.329	89.6	2.77	8.5 . . 12.0	36
.362	87.9	3.27	. .	
1891.34	88.2	3.05	8.7 . . 12.5	

A and B.

1891.326	306.9	176.73	. .	36
.329	306.9	176.58	. .	36
.345	306.5	176.72	. .	12
.348	306.7	176.89	. .	12
1891.34	306.8	176.73	. .	

There is no change in the double companion to *Regulus* since my first measures in 1878, and therefore both have the same proper motion as the large star, which is 0″.267 in the direction of 274°.5.

β 911.

R. A. 10h 2m 42s
Decl. — 19° 12′

A and B.

1892.055	313.7	4.66	7.5 . . 11.5	36
.115	312.3	4.78	7.5 . . 10.8	36
.153	314.2	4.87	7.0 . . 9.7	36
1892.10	313.4	4.77	7.3 . . 10.7	

A and C.

1892.055	79.2	49.46	. . 11.0	36
.115	79.2	49.10	. . 10.0	36
.153	79.0	49.45	. . 9.0	36
1892.10	79.1	49.34	. . 10.0	

A and B have a common proper motion of 0″.374 in the direction of 204°.2.

β 593. λ Hydrae.

R. A. 10h 4m 44s
Decl. — 11° 46′

1892.055	119.0	53.08	4.0 . . 13.5	36
.115	118.7	53.78	. . 13.5	36
.153	118.6	53.89	. . 13.0	36
1892.10	118.8	53.58	. . 13.3	

The distance is increasing from proper motion.

Σ 1424. γ Leonis.

R. A. 10h 13m 20s
Decl. + 20° 27′

1889.291	113.8	3.64	. . .	36
.293	113.3	3.42	. . .	36
.302	116.7	3.48	. . .	36
1889.29	114.6	3.51	. . .	

These measures were made while looking for a suspected close star.

β 219.

R. A. 10h 15m 56s
Decl. — 21° 55′

1892.230	187.5	2.10	6.8 . . . 8.0	36
.263	184.4	2.02	6.7 . . . 8.0	36
.299	187.2	2.08	7.5 . . . 9.5	12
1892.26	186.4	2.07	7.0 . . . 8.5	

Change doubtful.

0Σ 222.

R. A. 10h 30m 29s
Decl. + 60° 45′

1891.285 Absolutely round, with all powers. Splendid seeing. 36-inch.

DEMBOWSKI, in measuring the 0Σ companion, 5″ distant, thought the principal star was elongated.

β 411.

R. A. 10h 30m 25s
Decl. — 26° 3′

1892.230	286.7	1.02	6.0 . . . 7.5	36
.299	291.4	1.10	6.8 . . . 8.5	12
.309	286.9	1.12	6.5 . . . 8.5	12
1892.28	288.3	1.08	6.4 . . . 8.2	

0Σ 224.

R. A. 10h 33m 26s
Decl. + 9° 28′

1892.362	310.0	0.47	7.0 . . . 8.5	36
.364	313.4	0.46	8.0 . . . 8.5	36
.381	320.4	0.46	7.0 . . . 8.5	36
.383	310.8	0.52	7.5 . . . 8.5	36
1892.37	313.6	0.48	7.4 . . . 8.5	

This pair has been under observation since 1843, and there is now no doubt concerning the physical relation of the components. The period is evidently a long one, since the angular motion is only about 60° in the time covered by the measures. It is always close enough to be difficult, with most of the instruments used, in measuring it, and therefore some of the observations have large errors in the position-angles. The total change, however, is sufficient to obtain the approximate elements, and for this purpose I have collected all the measures, and give them below in chronological order:

1843.22	13.7	0.35	Madler	2 n
1844.31	20±	. . .	O. Struve	2 n
1845.30	13.6	0.20	Madler	1 n
1851.27	352.6	0.48	O. Struve	1 n
1851.28	17.5	0.25	Madler	1 n
1857.34	3.6	. . .	Secchi	1 n
1861.26	348.8	0.59	O. Struve	1 n
1868.03	339.2	0.5±	Dembowski . . .	4 n
1871.31	328.4	0.59	O. Struve	1 n
1872.31	336.8	0.55	O. Struve	1 n
1873.23	329.8	. . .	Dembowski . . .	4 n
1879.32	315.7	0.35	Schiaparelli . . .	4 n
1880.16	334.3	0.62	Burnham	1 n
1881.25	316.6	. . .	Doberck	2 n
1882.27	309.9	. . .	Doberck	1 n
1883.71	330.2	0.53	Engelmann . . .	7 n
1884.21	326.0	0.55	Perrotin	4 n
1887.27	315.6	0.52	Schiaparelli . . .	4 n
1892.37	313.6	0.48	Burnham	4 n

This pair should be carefully measured every few years for some time to come.

0Σ 225.

R. A. 10h 33m 35s
Decl. + 19° 52′

A and B (PERROTIN).

1892.118	239.6	0.86	8.0 . . 11.5	36
.156	241.0	0.80	8.5 . . 11.5	36
.189	244.3	0.69	8.0 . . 10.5	36
1892.15	241.6	0.78	8.2 . . 11.2	

A and C (0Σ 225).

1892.118	352.8	6.55	. . 10.0	36
.156	353.3	6.45	. . 10.8	36
.189	352.6	6.55	. . 9.5	36
1892.15	352.9	6.52	. . 10.1	

Close star discovered by PERROTIN.

β 913. 40 Leonis Minoris.

R. A. 10h 36m 27s
Decl. + 26° 57′

1892.036	120.4	12.32	6.0 . . 13.0	36
.175	120.2	12.05	6.0 . . 12.0	36
.227	119.1	12.43	6.0 . . 13.0	36
1892.14	119.9	12.27	6.0 . . 12.7	

Distance increasing.

β 596. Leonis 222.

R. A. $10^h\ 43^m\ 2^s$
Decl. $+\ 17^\circ\ 47'$

1891.246	279°.4	2".32	6.8 . . 11.7	36
.301	279.8	2.65	6.5 . . 11.5	36
.304	276.7	2.71	6.7 . . 12.0	36
1891.28	278.6	2.56	6.7 . . 11.7	

Madler 4.

R. A. $10^h\ 47^m\ 38^s$
Decl. $-\ 1^\circ\ 29'$

1891.227 Round with 1500 on 36-inch.

Given as a close pair by MADLER. I have never been able to see any certain elongation, and it is probably not really double.

β 598. 59 Leonis.

R. A. $10^h\ 54^m\ 32^s$
Decl. $+\ 6^\circ\ 45'$

1892.036	221°.1	46".34	5.5 . . 13.8	36
.151	221.1	45.85	6.0 . . 13.5	36
.170	221.3	45.96	. . 13.0	36
1892.12	221.2	46.05	5.7 . . 13.4	

β 1077. α Ursae Majoris.

R. A. $10^h\ 56^m\ 19^s$
Decl. $+\ 62^\circ\ 24'$

1890.249	317°.4	0".87	. . .	36
.252	322.9	0.83	. . .	36
.255	321.3	0.79	. . .	36
.269	318.6	1.00	. . .	36
1890.26	320.1	0.87	. . .	
1891.285	320.0	0.74	. . 10.5	36
.301	316.0	0.74	. . 11.0	36
.304	315.6	0.94	. . 11.5	36
.326	315.5	0.78	. . 11.0	36
1891.30	316.8	0.80	. . 11.0	
1892.057	310.1	0.80	. .	36
.118	312.9	0.82	. .	36
.156	311.5	0.71	. .	36
1892.11	311.5	0.78		

A most interesting binary.

β 599. 65 Leonis.

R. A. $11^h\ 0^m\ 47^s$
Decl. $+\ 2^\circ\ 36'$

1889.258	88°.0	1".87	5½ . . 10.5	36
.274	87.6	1.74	5.8 . . 10.5	36
.285	89.9	1.72	5.5 . . 10.5	36
1889.27	88.5	1.78	5.6 . . 10.5	

A neighboring star, 55 *Leonis*, was found to be a new pair, and after observing that, this pair was measured. Change is doubtful.

1878.20	82°.4	1".78	β	4 n

β 916. Crateris 31.

R. A. $11^h\ 8^m\ 13^s$
Decl. $-\ 14^\circ\ 47'$

1889.134	359°.0	1".03	7.5 . . . 8.0	36
.312	361.8	0.90	7.5 . . . 8.5	36
.323	359.8	0.70	7.5 . . . 8.3	36
1889.25	360.2	0.88	7.5 . . . 8.3	

No earlier measures except an angle of 357°.9 (1879.27) at Cin.

β 600. Crateris 36.

R. A. $11^h\ 10^m\ 54^s$
Decl. $-\ 6^\circ\ 29'$

A and B.

1892.153	215°.6	1".14	. . 13.0	36
.186	216.4	1.33	. . 13.0	36
1892.17	216.0	1.23	. . 13.0	

A and C (= *H N* 26).

1892.151	97°.6	60".50	6.5 . . . 8.5	36
.153	97.6	60.35	6.5 . . . 8.5	36
.186	97.7	60.52	7.0 . . . 8.7	36
1892.16	97.6	60.46	6.7 . . . 8.6	

Σ 1540. 83 Leonis.

R. A. $11^h\ 20^m\ 42^s$
Decl. $+\ 3^\circ\ 40'$

1892.362	149°.6	29".23	. . .	36
.370	150.3	29.13	. . .	12
.373	150.6	29.48	. . .	12
.378	150.6	29.08	. . .	12
1892.37	150.2	29.23	. . .	

Common proper motion.

0Σ 234.

R. A. 11h 24m 20s
Decl. + 41° 57′

1891.225	102°.6	0″.14	7.5 . . . 8.0	36
.227	105.6	0.14	7.8 . . . 8.5	36
.244	104.4	0.13	. . .	36
1891.23	104.2	0.14	. . .	
1892.186	106.7	0.19	8.0 . . . 8.6	36
.189	111.9	0.18	8.0 . . . 8.5	36
.381	118.3	0.18	. . .	36
.383	119.9	0.16	. . .	36
1892.28	114.2	0.18	. . .	

Gore finds a period of 63.4 years.

0Σ 235.

R. A. 11h 25m 31s
Decl. + 61° 45′

1892.060	81°.9	0″.98	6.0 . . . 8.5	36
.151	84.6	1.05	6.0 . . . 8.5	36
.153	86.5	0.89	5.5 . . . 7.0	36
1892.12	84.3	0.97	5.8 . . . 8.0	

β 456.

R. A. 11h 30m 44s
Decl. — 11° 41′

1892.364	274°.6	0″.47	9.0 . . . 9.1	36
.381	274.2	0.44	8.5 . . . 8.7	36
.383	273.7	0.46	8.7 . . . 9.1	36
1892.37	274.2	0.46	8.7 . . . 9.0	

Binary in rapid motion.

β 917.

R. A. 11h 37m 25s
Decl. + 11° 22′

1892.227	176°.4	3″.61	8.3 . . 10.0	36
.230	178.2	3.55	8.0 . . 10.5	36
.263	176.7	3.61	8.0 . . 10.5	36
1892.24	177.1	3.59	8.1 . . 10.3	

Unchanged.

β 602.

R. A. 11h 40m 39s
Decl. + 15° 40′

1891.282	78°.9	0″.45	8.3 . . 11.0	36
.285	80.0	0.47	8.0 . . 11.0	36
.326	81.1	0.48	8.5 . . 11.0	36
1891.30	80.0	0.47	8.3 . . 11.0	

β 603. Leonis 472.

R. A. 11h 42m 28s
Decl. + 14° 57′

1891.244	327°.0	1″.29	6.5 . . 10.5	36
.246	331.3	1.20	6.3 . . 10.5	36
.282	327.8	1.00	6.5 . . 10.0	36
1891.26	328.7	1.16	6.4 . . 10.2	

Angle diminishing.

β 604. β Leonis.

R. A. 11h 42m 56s
Decl. + 15° 15′

1892.151	349°.5	78″.33	. . 14.5	36
.227	348.6	77.87	. . 13.5	36
1892.19	349.0	78.10	. . 14.0	

H 4478. β Hydrae.

R. A. 11h 46m 51s
Decl. — 33° 14′

1889.427	349°.2	1″.57	. . .	12
.430	350.0	1.52	. . .	12
.433	349.5	1.49	. . .	12
1889.43	349.6	1.53	. . .	

β 794.

R. A. 11h 47m 13s
Decl. + 74° 26′

A and B.

1890.326	125°.8	0″.40	. . .	36
.337	129.1	0.59	. . .	36
.373	127.3	0.53	. . .	36
.375	125.4	0.48	. . .	36
1890.35	126.9	0.50	. . .	
1891.285	132.7	0.42	7.3 . . . 8.5	36
.301	134.4	0.46	7.0 . . . 9.0	36
.304	133.0	0.42	7.0 . . . 8.5	36
1891.30	133.4	0.43	7.1 . . . 8.7	
1892.118	138.8	0.48	7.0 . . . 8.5	36
.153	135.4	0.41	7.0 . . . 9.5	36
.189	136.6	0.37	8.0 . . . 9.5	36
1892.15	136.9	0.42	7.3 . . . 9.2	

AB and C.

1890.373	72°.0	5″.64	. . 14.0	36
.375	71.7	5.79	. . 13.5	36
1890.37	71.8	5.71	. . 13.7	

	°	″		
1891.285	72.0	5.56	. . 14.0	36
.301	71.2	5.65	. . 14.5	36
.304	73.7	5.40	. . 14.0	36
1891.30	72.3	5.54	. . 14.2	
1892.118	72.4	5.54	. . 13.5	36
.153	74.5	5.52	. . 13.8	36
.186	72.6	5.89	. . 13.8	36
1892.15	73.2	5.65	. . 13.7	

AB and D.

	°	″		
1890.373	78.7	26.79	. . 13.0	36
.375	78.5	26.67	. . 13.0	36
1890.37	78.6	26.73	. . 13.0	

The two distant companions were found with the 36-inch. There seems to be considerable change in the close pair.

	°	″		
1881.34	106.6	0.42	β	5 n

β 918.

R. A. $11^h\ 50^m\ 36^s$
Decl. $+\ 32^\circ\ 52'$

	°	″		
1891.217	234.9	7.13	6.5 . . 13.0	36
.225	233.4	7.43	6.3 . . 12.5	36
.227	234.5	7.42	6.3 . . 12.5	36
1891.22	234.3	7.33	6.4 . . 12.7	

No change.

β 919.

R. A. $11^h\ 52^m\ 7^s$
Decl. $+\ 33^\circ\ 49'$

	°	″		
1891.217	13.8	4.54	6.3 . . 11.5	36
.225	15.8	4.59	6.4 . . 11.5	36
.227	13.3	4.67	6.0 . . 12.0	36
1891.22	14.3	4.60	6.2 . . 11.7	

β 3123.

R. A. $12^h\ 0^m\ 0^s$
Decl. $+\ 69^\circ\ 22'$

	°	″		
1892.118	199.5	0.35	7.5 . . . 7.5	36
.153	198.0	0.33	8.0 . . . 8.0	36
.156	202.6	0.42	8.0 . . . 8.0	36
1892.14	200.0	0.37	7.8 . . . 7.8	

There is, perhaps, not another double star in STRUVE'S great work, *Mensuræ Micrometricæ*, which has been measured so rarely as β 3123. It has been known for more than sixty years, and yet at the most there are but five sets of measures, and two of these are within the last ten years. The scarcity of measures is undoubtedly due to the fact that it is at all times a difficult pair, and beyond the reach of many telescopes used in micrometrical work. There are some observations showing that this star, at various times, was apparently single.

The following are both the positive and the negative results, arranged in chronological order:

	°	″		
1832.20	289.7	0.3	W. Struve .	3 n
1840.43	265±	obl.	O. Struve . .	2 n
1841.41	268.7	0.44	O. Struve . .	1 n
1841.56	275.3	0.3±	Madler	1 n
1842.78	292.3	0.2±	Madler	1 n
1851.44	Elong. in 231° (?)		O. Struve . .	1 n
1858.44	Single.		O. Struve . .	1 n
1861 26	Single.		O. Struve . .	1 n
1862.39	Single.		O. Struve . .	1 n
1862.95	Single.		Dembowski	1 n
1868.56	Single.		O. Struve . .	1 n
1881.32	Round.		Bigourdan .	1 n
1881.38	221.9	0.32	Burnham . .	2 n
1892.14	200.0	0.37	Burnham . .	3 n

A careful examination of these observations shows that probably this is a case of slow angular motion, with very little change in the distance. The motion is retrograde, and the distance cannot have been at any time much less than 0″.3. An annual motion of about 1°.5 in position-angle will represent the observations as well as could be expected in a pair of this kind. My measures in 1881 were made with the 15½-inch refractor of the WASHBURN Observatory, with which this pair was well seen. The last measures were made here with the 36-inch. With the larger telescope, of course, such a pair is very easy under any suitable conditions, and the observations should represent the relations of the components very accurately. The two stars are sensibly equal in magnitude, but there is hardly any doubt about the quadrant, because the angular change between 1832 and 1841, and between 1881 and 1892, would seem to show that there could not have been an occultation during the intervening time when it was not seen double, nor any considerable diminution in the distance. Evidently this is not so interesting a binary as heretofore supposed, since the angular motion in sixty years is only about 90°.

Σ 1603.

R. A. 12h 2m 8s
Decl. + 56° 8′

1892.362	81.8	22.28	...	36
.370	81.8	22.43	...	12
.373	81.9	22.26	...	12
.378	81.3	22.22	...	12
1892.37	81.7	22.30	...	

Σ 1604.

R. A. 12h 3m 15s
Decl. — 11° 11′

A and B.

1892.370	91.0	10.43	...	12
.373	92.2	10.58	...	12
.378	91.4	11.09	...	12
1892.37	91.5	10.70	...	

A and C.

1892.370	91.9	39.09	...	12
.373	91.7	39.18	...	12
.378	92.0	39.29	...	12
1892.37	91.9	39.19	...	

β 920. Corvi 17.

R. A. 12h 9m 34s
Decl. — 22° 41′

1892.230	253.5	0.78	6.0 ... 8.0	36
.263	253.0	0.85	6.5 ... 8.5	36
.269	251.6	0.73	6.8 ... 8.6	36
1892.25	252.4	0.79	6.4 ... 8.4	

Change of 20° in the angle since 1879.

β 921.

R. A. 12h 11m 42s
Decl. 23° 21′

1892.230	216.4	2.98	8.0 .. 11.0	36
.263	218.3	3.28	7.8 .. 10.5	36
.269	217.1	3.33	7.0 .. 9.5	36
1892.25	217.3	3.20	7.6 .. 10.3	

Without change.

β 605. B.A.C. 4149.

R. A. 12h 13m 58s
Decl. — 21° 30′

1891.285	146.4	1.14	6.5 ... 7.7	36
.326	142.7	1.00	6.0 ... 8.5	36
.331	142.3	0.95	6.0 ... 9.0	36
1891.32	143.8	1.03	6.2 ... 8.4	

Change uncertain.

0Σ 247 rej.

R. A. 12h 16m 40s
Decl. — 3° 58′

1891.282 Round with all powers. Good seeing.

MADLER. in 1848. thought this star was elongated. I have never been able to see any trace of it with other instruments. and it is certainly single with the 36-inch.

0Σ 248.

R. A. 12h 18m 4s
Decl. — 6° 38′

1891.282 No sign of duplicity. Good seeing.

This was also thought to be elongated by MADLER. It was rejected as single by 0Σ in the catalogue of 1850.

Σ 1639.

R. A. 12h 18m 25s
Decl. + 26° 15′

1892.364 No elongation with 1500. Fine seeing.

This pair has been closing up until it is now apparently single with the 36-inch under very favorable conditions. The last measure is by SCHIAPARELLI in 1887, when the distance was 0.2.

β 606. Corvi 35.

R. A. 12h 19m 48s
Decl. — 14° 17′

1891.225	100.6	1.26	7.3 ... 8.0	36
.274	98.7	1.32	7.0 ... 8.5	36
.282	98.1	1.18	...	36
1891.26	99.1	1.25	7.2 ... 8.2	

β 922.

R. A. 12h 19m 58s
Decl. — 3° 49′

1891.225	165°.9	0″.73	8.3 . . . 8.7	36
.285	166.3	0.71	8.0 . . . 8.7	36
.301	163.7	0.79	8.0 . . . 9.3	36
1891.27	165.3	0.74	8.1 . . . 8.9	

β 923.

R. A. 12h 22m 11s
Decl. + 5° 4′

1892.115	61°.6	2″.66	7.0 . . 11.5	36
.118	59.6	2.74	6.5 . . 12.0	36
.151	61.2	2.59	7.0 . . 12.5	36
1892.13	61.8	2.66	6.8 . . 11.7	

β 28. B.A.C. 4213.

R. A. 12h 23m 54s
Decl. — 12° 44′

1891.225	9°.1	1″.90	6.6 . . 8.0	36
.274	10.2	1.81	6.8 . . 10.0	36
.282	5.5	1.93	6.5 . . 10.0	36
1891.26	8.6	1.81	6.6 . . . 9.3	

β 607.

R. A. 12h 35m 2s
Decl. — 0° 48′

1889.296	314°.3	1″.18	9.0 . . 10.2	36
.312	317.5	1.23	9.0 . . 10.0	36
.323	317.2	1.18	9.0 . . 10.0	36
1889.31	316.3	1.20	9.0 . . 10.0	

Near *γ Virginis*, 35s p. There seems to be no material change.

1878.23	315°.9	1″.15	β	6 n

Σ 1670. γ Virginis.

R. A. 12h 35m 37s
Decl. — 0° 47′

A and B.

1889.296	153°.0	5″.58	. . .	36
.312	154.3	5.67	. . .	36
.323	153.0	5.90	. . .	36
1889.31	153.4	5.72	. . .	

A and C.

1889.293	159°.0	53″.43	. . 15.0	36
.296	158.2	52.81	. . 14.5	36
.312	161.0	53.12	. . 14.0	36
1889.30	159.4	53.12	. . 14.5	

The faint star measured as a light-test. It should not be confounded with a bright star about twice as far in the direction of 88°. This was called 15m by HERSCHEL, but would be about 11m of the scale used here, which would make it twenty-five times as bright as the other star.

β 924. 31 Virginis.

R. A. 12h 35m 53s
Decl. + 7° 28′

1891.225	30°.6	3″.97	5.0 . . 11.5	36
.241	28.4	3.88	. . 11.5	36
.244	27.9	3.98	. .	36
1891.24	29.0	3.94	. . 11.5	

β 925.

R. A. 12h 51m 6s
Decl. + 44° 12′

1892.115	213°.0	6″.95	6.4 . . 11.0	36
.118	210.9	6.90	6.0 . . 11.8	36
.151	211.9	6.84	6.5 . . 11.5	36
1892.13	211.9	6.90	6.3 . . 11.4	

Without change.

β 926.

R. A. 12h 52m 13s
Decl. — 5° 24′

1892.227	274°.4	2″.11	8.3 . . 12.0	36
.230	277.8	2.10	8.5 . . 10.5	36
.263	272.1	2.51	8.2 . . 10.5	36
1892.24	274.8	2.24	8.3 . . 11.0	

β 112. P XII. 243.

R. A. 12h 54m 46s
Decl. + 19° 1′

B and C.

1892.115	292°.0	1″.61	9.0 . . 9.2	36
.151	294.0	1.98	9.5 . . 10.0	36
.173	295.0	1.98	9.5 . . 10.3	36
1892.14	293.7	1.86	9.3 . . 9.8	

A and B.

1892.115	348°.8	150".83	6.0 . .	36
.151	349.0	150.58	6.0 . .	36
1892.13	348.9	150.70	6.0 . .	

β 927.

R. A. 12h 56m 34s
Decl. — 5° 53′

1892.227	292°.5	4".41	8.3 . . 10.0	36
.263	290.3	4.17	8.0 . . 10.0	36
.302	291.6	4.03	8.2 . . 10.5	36
1892.26	291.5	4.20	8.2 . . 10.2	

β 928.

R. A. 12h 57m 10s
Decl. — 5° 57′

1892.230	313°.9	2".00	8.0 . . . 9.0	36
.263	311.5	2.09	8.0 . . . 8.0	36
.269	312.9	1.94	8.0 : . . 9.3	36
1892.25	312.8	2.01	8.0 . . . 9.0	

β 1082. 78 Ursae Majoris.

R. A. 12h 55m 35s
Decl. + 57° 1′

1890.252	77°.4	1".35	. . .	36
.255	78.1	1.43	. . .	36
.280	75.1	1.61	. . .	36
1890.26	76.9	1.46	. . .	

β 929. 48 Virginis.

R. A. 12h 57m 43s
Decl. — 3° 5′

1891.225	220°.4	0".55	6.0 . . . 6.3	36
.274	224.2	0.49	. . .	36
.282	219.1	0.46	. . .	36
1891.26	221.2	0.50	. . .	

Angle diminishing.

β 798.

R. A. 12h 59m 40s
Decl. — 17° 21′

1892.400	172°.9	0".48	8.0 . . . 8.5	36
.403	172.3	0.41	8.3 . . . 8.6	36
1892.40	172.6	0.44	8.1 . . . 8.5	

No certain change.

β 930. B.A.C. 4389.

R. A. 13h 0m 28s
Decl. + 45° 54′

1891.217	112°.4	2".67	6.5 . . 11.0	36
.225	113.0	2.50	6.2 . . 11.0	36
.274	114.6	2.84	6.0 . . 12.0	36
1891.24	113.3	2.67	6.2 . . 11.3	

β 799.

R. A. 13h 1m 7s
Decl. + 73° 40′

1891.285	248°.0	0".71	7.0 . . . 9.5	36
.301	242.3	0.74	7.3 . . . 9.5	36
.326	245.6	0.67	7.0 . . . 8.5	36
1891.30	245.3	0.71	7.1 . . . 9.2	

Angle probably increasing.

Σ 1728. 42 Comae.

R. A. 13h 4m 10s
Decl. + 18° 10′

1890.326	8°.0	0".84	. . .	36
.331	10.2	0.54	. . .	12
.334	7.8	0.66	. . .	36
.337	11.4	0.78	. . .	36
1890.33	9.3	0.70	. . .	

β 609.

R. A. 13h 4m 28s
Decl. — 4° 18′

1889.302	351°.6	0".87	6.8 . . 10.0	36
.312	342.9	0.94	7.0 . . 9.5	36
.323	352.7	0.92	6.5 . . 10.0	36
1889.31	349.1	0.91	6.8 . . 9.8	

Poor seeing when the second measure was made. Very little, if any, change.

1878.32	356°.1	0".89	β	1 n

Σ 1733.

R. A. 13h 10m 27s
Decl. + 17° 53′

1890.331	126°.0	4".50	8.5 . . 10.0	12
.334	126.6	4.93	. .	36
.337	125.8	4.97	. .	36
1890.33	126.1	4.80	. .	

No change since STRUVE.

β 800. Comae 201.

R. A. 13h 10m 49s
Decl. + 17° 40′

	°	″		
1890.331	113.5	2.13	8.0 . . 10.5	12
.334	116.0	1.96	7.0 . . 10.0	36
.337	116.9	1.98	7.5 . . 10.0	36
1890.33	115.5	2.02	7.5 . . 10.2	
1891.225	116.1	2.09	6.8 . . 10.0	36
.241	114.2	2.21	7.0 . . 11.0	36
.274	114.6	2.40	7.8 . . 11.0	36
1891.25	115.0	2.23	7.2 . . 10.7	

β 610. Virginis 504.

R. A. 13h 17m 28s
Decl. — 20° 19′

	°	″		
1892.230	20.9	3.48	7.8 . . 11.5	36
.263	19.5	3.83	7.0 . . 9.5	36
.269	20.4	3.77	7.7 . . 10.0	36
1892.25	20.3	3.69	7.5 . . 10.3	

β 460.

R. A. 13h 18m 40s
Decl. — 15° 0′

	°	″		
1892.395	32.2	2.24	8.0 . . 10.0	12
.397	32.3	2.21	8.5 . . 10.4	12
.400	37.3	1.94	7.8 . . 9.6	36
1892.39	33.9	2.13	8.1 . . 10.0	

OΣ 267.

R. A. 13h 23m 9s
Decl. + 76° 36′

	°	″		
1891.225	309.2	0.35	. . .	36
.227	308.6	0.24	. . .	36
.244	309.8	0.27	. . .	36
1891.23	309.2	0.29	. . .	

β 113.

R. A. 13h 23m 9s
Decl. + 12° 6′

	°	″		
1891.225	194.0	1.45	8.0 . . 9.5	
.241	198.6	1.39	8.0 . . 10.0	
.274	198.9	1.51	8.0 . . 11.0	
1891.25	197.2	1.45	8.0 . . 10.2	

OΣ 269.

R. A. 13h 27m 26s
Decl. + 35° 52′

	°	′		
1891.227	213.8	0.22	7.5 . . . 8.0	
.277	212.0	0.24	7.0 . . . 7.5	
.282	214.3	0.20	7.0 . . . 7.5	
1891.26	213.4	0.22	7.2 . . . 7.7	
1892.400	216.2	0.22	7.5 . . . 7.8	36
.403	213.9	0.20	. . .	36
1892.40	215.0	0.21	7.5 . . . 7.8	

The period is probably about forty-eight years. (See *Observatory*, July, 1891.)

Σ 1768. 25 Canes Ven.

R. A. 13h 32m 7s
Decl. + 36° 54′

	°	″		
1892.156	137.7	0.83	5.0 . . . 9.0	36
.170	138.5	1.04	5.0 . . . 8.0	36
.186	136.4	1.08	. . .	36
1892.17	137.5	0.98	5.0 . . . 8.5	

β 934.

R. A. 13h 33m 0s
Decl. + 51° 3′

	°	″		
1891.301	268.2	1.26	9.0 . . . 9.0	36
.304	266.0	1.24	9.0 . . . 9.0	36
.326	265.4	1.27	9.3 . . . 9.3	36
1891.31	266.5	1.26	9.1 . . . 9.1	

β 612. B.A.C. 4559.

R. A. 13h 33m 40s
Decl. + 11° 21′

	°	″		
1891.274	188.4	0.34	6.5 . . . 6.5	36
.277	191.1	0.29	6.0 . . . 6.2	36
.282	193.7	0.21	6.8 . . . 6.9	36
1891.28	191.1	0.28	6.4 . . . 6.5	
1892.118	198.7	0.35	6.5 . . . 6.6	36
.151	199.3	0.33	6.0 . . . 6.1	36
.153	198.1	0.25	6.5 . . . 6.7	36
1892.14	198.7	0.31	6.3 . . . 6.5	

Binary in rapid motion. GLASENAPP has recently computed the orbit, using the measures given above, and finds a period of 30.00 years. (*Astronomy and Astro-Physics*, June, 1892.)

β 115.

R. A. 13h 39m 24s
Decl. + 9° 40′

1891.225	226°.5	1″.74	8.0 . .	9.5	36
.241	219.2	1.63	8.0 . .	11.3	36
.274	225.1	1.56	8.0 . .	10.5	36
1891.25	223.6	1.64	8.0 . .	10.4	

β 935. 86 Virginis.

R. A. 13h 39m 33s
Decl. — 11° 49′

A and B.

1889.293	298°.0	1″.54	6.0 . .	10.0	36
.296	299.8	1.87	6.0 . .	10.0	36
.302	300.9	1.58	5.5 . .	10.0	36
1889.30	299.6	1.66	5.8 . .	10.0	

C and D.

1889.293	276°.1	2″.08	10.0 . .	11.0	36
.296	276.4	2.37	10.5 . .	11.0	36
.302	275.3	2.28	11.0 . .	11.5	36
1889.30	275.9	2.24	10.5 . .	11.2	

A and C (= Σ 1780 rej.).

1889.293	164°.2	27″.24	. . .		36
.296	165.5	27.09	. . .		36
.302	165.2	27.19	. . .		36
1889.30	164.6	27.17	. . .		

A beautiful quadruple star. It was observed by *H* and Σ as a double, but they failed to notice that each of the stars was double. Thus far there seems to be little evidence of change.

1879.37	298°.4	1″.61	β	5 n	AB
1879.40	274.2	1.72	β	3 n	CD
1879.33	164.7	26.94	β	2 n	AC

The 36-inch shows two new nebula in the field with this quadruple. They are small and diffused, and not very faint One is 4½s p, and 136″.8 s; and the other 19½s p, and 101″.6 s.

β 413.

R. A. 13h 42m 15s
Decl. — 27° 46′

1889.392	109°.5	77″.74	8.0 . .	10.0	12
.397	109.5	77.58	7.5 . .	8.5	36
1889.39	109.5	77.66	7.7 . .	9.2	

Large star deep red.

β 343. Centauri 219.

R. A. 13h 45m 8s
Decl. — 31° 1′

1889.351	129°.2	1″.98	6.0 . . .	8.5	12
.373	129.3	2.11	6.7 . . .	7.2	12
.383	129.2	1.28	6.0 . . .	6.3	36
.386	131.2	1.41	6.0 . . .	6.2	36
1889.37	129.7	1.70	6.2 . . .	7.1	

Σ 1785.

R. A. 13h 43m 38s
Decl. + 27° 35′

1892.362	247°.5	1″.51	7.8 . . .	8.0	36
.364	250.3	1.46	7.5 . . .	8.0	36
.378	248.1	1.41	. . .		12
1892.37	248.6	1.46	. . .		

For a complete list of the measures of this binary, see *Monthly Notices*, December, 1892.

β 613.

R. A. 13h 46m 3s
Decl. + 35° 16′

A and B.

1892.115	149°.1	0″.76	9.3 . . .	9.3	36
.118	148.4	0.76	9.0 . . .	9.0	36
.151	151.7	0.69	9.0 . . .	9.0	36
1892.13	149.7	0.73	9.1 . . .	9.1	

AB and C.

1892.118	83°.1	48″.76	. . .	9.0	36
.189	83.3	48.74	. . .	9.0	36
1892.15	83.2	48.75	. . .	9.0	

β 614.

R. A. 13h 48m 2s
Decl. + 10° 44′

1889.383	270°.4	0″.43	8.0 . .	11.0	36
.400	273.4	0.41	7.5 . .	11.5	36
.406	269.4	0.49	8.0 . .	11.0	36
1889.40	271.1	0.44	7.8 . .	11.2	

This is *O*Σ 271 *rej.* The only other measures are:

1878.38	268°.3	0″.60	β	2 n

β 936.

R. A. 13h 51m 3s
Decl. + 35° 13′

1892.115	94°.2	4″.70	8.7 . . 11.0	36
.118	96.5	4.56	8.3 . . 11.0	36
.151	96.8	4.49	8.5 . . 12.0	36
1892.13	95.8	4.58	8.5 . . 11.3	

β 30.

R. A. 13h 52m 25s
Decl. + 20° 2′

1892.227	199°.2	7″.87	8.0 . . 10.7	36
.230	200.7	8.12	8.0 . . 11.0	36
.263	200.2	8.17	8.0 . . 9.5	36
1892.24	200.0	8.05	8.0 . . 10.4	

Swift.

R. A. 13h 57m 40s
Decl. + 46° 55′

1889.386	8°.2	2″.27	8.5 . . . 8.5	36
.389	5.2	2.62	9.5 . . . 9.5	12
1889.39	6.7	2.44	9.0 . . . 9.0	

Discovered by Dr. LEWIS SWIFT in the course of his work on nebulæ. It has not been measured before.

β 938.

R. A. 13h 59m 29s
Decl. — 26° 0′

1892.395	116°.0	0″.72	8.0 . . . 8.2	12
.400	112.1	0.62	8.0 . . . 8.2	36
.403	123.2	0.61	7.8 . . . 8.2	36
1892.40	117.1	0.65	7.9 . . . 8.2	

β 803.

R. A. 14h 4m 46s
Decl. — 2° 6′

1892.400	226°.2	5″.47	7.5 . . 11.5	36
.403	226.4	5.75	7.0 . . 11.0	36
.405	227.0	5.41	7.6 . . 11.5	36
1892.40	226.5	5.54	7.4 . . 11.3	

β 940. 52 Hydrae.

R. A. 14h 21m 9s
Decl. — 28° 57′

1889.378	279°.3	4″.05	. . 11.0	36
.383	279.3	4.22	. . 10.5	36
.386	277.5	4.53	. . 11.0	36
1889.38	278.7	4.27	. . 10.8	

The only prior measures are as follows:

1879.42	276°.8	4″.00	β	3 n

Σ 1834.

R. A. 14h 15m 54s
Decl. + 49° 3′

1892.156	123°.3	0″.30	8.5 . . . 8.5	36
.186	127.0	0.22	8.0 . . . 8.2	36
1892.17	125.1	0.26	8.2 . . . 8.3	

The distance of this pair, when it was measured by STRUVE in 1831, was 1″.36. The change in angle is only 12°.

β 1111. *P XIV* 69.

R. A. 14h 17m 29s
Decl. + 9° 0′

B and C.

1892.151	335°.3	0″.23	8.5 . . . 8.5	36
.153	334.0	0.20	8.5 . . . 8.5	36
.186	340.2	0.18	8.0 . . . 9.0	36
.189	335.0	0.21	8.0 . . . 8.5	36
1892.17	336.1	0.21	8.2 . . . 8.6	

A and BC (= Σ 1835).

1892.153	189°.4	6″.25	5.0 . . .	36
.186	189.2	6.25	5.0 . . .	36
1892.17	189.3	6.25	5.0 . . .	

The close pair is in rapid motion. No material change in C since 1832.

β 615.

R. A. 14h 17m 52s
Decl. + 49° 4′

1892.156	236°.3	2″.92	8.4 . . 8.8	36
.170	237.9	2.64	8.5 . . 10.0	36
.186	235.7	2.96	8.6 . . 10.5	36
1892.17	236.6	2.84	8.5 . . 9.8	

β 462.

R. A. 14h 23m 46s
Decl. — 3° 11′

1891.225	323°.6	2″.19	9.0 . . . 9.0	36
.274	322.8	2.15	9.0 . . . 9.0	36
.392	329.0	2.15	9.2 . . . 9.3	36
1891.30	325.1	2.16	9.1 . . . 9.1	

β 616. γ Bootis.

R. A. 14h 27m 15s
Decl. + 38° 50′

1891.217	103°.2	28″.27	. . 13.5	36
.225	104.0	28.36	. . 14.0	36
.285	103.5	28.06	. . 14.0	36
1891.24	103.6	28.23	. . 13.8	

β 804.

R. A. 14h 31m 42s
Decl. — 8° 9′

1891.225	163°.9	1″.39	8.5 . . 11.0	36
.274	162.2	1.19	8.5 . . 12.0	36
.277	156.5	1.29	8.3 . . 11.5	36
1891.26	160.9	1.29	8.4 . . 11.5	

β 806.

R. A. 14h 33m 27s
Decl. — 25° 46′

A and B. (New).

1890.375	96°.9	0″.70	7.5 . . 10.0	36
.383	96.1	0.72	7.0 . . 9.0	36
.406	95.9	0.59	7.5 . . 9.0	36
1890.39	96.3	0.67	7.3 . . 9.3	

C and D.

1890.375	343°.2	1″.34	8.0 . . . 9.0	36
.383	345.6	1.20	8.5 . . . 9.5	36
.406	345.9	1.07	8.5 . . . 9.0	36
1890.39	344.9	1.20	8.3 . . . 9.2	

A and C.

1890.375	67°.2	71″.28	. . .	36
.383	67.5	71.60	. . .	36
.406	67.3	71.57	. . .	36
1890.39	67.3	71.48	. . .	

A and a. (New.)

1890.375	330°.2	17″.78	. . 13.5	36
.383	329.0	17.79	. . 13.5	36
1890.38	329.6	17.78	. . 13.5	

The double companion to the principal star was discovered at the WASHBURN Observatory in 1881. The 36-inch shows that the larger star is also double, so that it is now a fine quadruple group. The following are the only other measures:

1881.44	347°.8	1″.22	CD	β	3 n
1881.42	67.4	71.50	AC	β	3 n

Σ 1863.

R. A. 14h 34m 1s
Decl. + 52° 6′

1892.323	91°.5	0″.63	8.0 . . . 8.0	36
.362	90.3	0.64	8.0 . . . 8.2	36
.364	91.1	0.61	. . .	36
1892.35	91.0	0.63	8.0 . . . 8.1	

Slow retrograde motion in angle.

β 345.

R. A. 14h 34m 40s
Decl. — 29° 11′

1892.362	302°.1	0″.91	8.0 . . . 8.6	36
.364	307.0	0.92	7.0 . . . 8.0	36
.381	301.3	0.98	7.5 . . . 8.0	36
1892.37	303.5	0.94	7.5 . . . 8.2	

β 414. Centauri 315.

R. A. 14h 34m 42s
Decl. — 30° 25′

1889.427	342°.9	1″.10	6.5 . . . 7.3	12
.430	347.0	1.01	. . .	12
.436	347.0	0.91	6.5 . . . 8.5	36
1889.43	345.6	1.01	6.5 . . . 7.9	

This is the first measure of this pair.

Σ 1865. ζ Bootis.

R. A. 14h 35m 25s
Decl. + 14° 15′

1891.282	108°.3	0″.47	. . .	36
.285	110.7	0.45	. . .	36
.362	108.4	0.50	. . .	36
1891.31	109.1	0.47	. . .	

Hn. 20. 5 Librae.

R. A. $14^h\ 39^m\ 21^s$
Decl. $-14^\circ\ 57'$

1889.378	247°.4	2".53	6.5 . . 11.0	36
.383	252.1	2.90	6.0 . . 11.5	36
.386	248.2	2.93	6.0 . . 11.5	36
1889.38	249.2	2.79	6.2 . . 11.3	

The only early measures are:

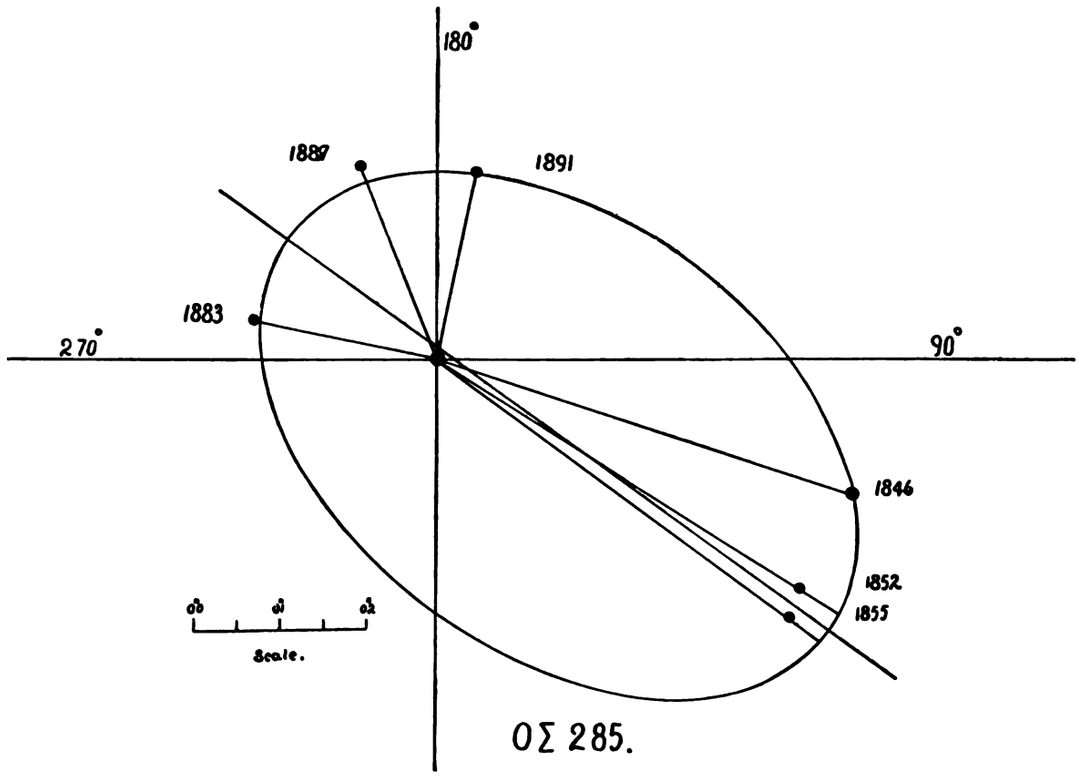
1881.43	249°.8	2".69	β	3 n

The Orbit of $O\Sigma$ 285.

S. W. Burnham.

[From *Sidereal Messenger*, June, 1891.]

This has always been a moderately close pair since its discovery by $O\Sigma$ more than half a century ago, and therefore but few measures have been made of it. No orbit has been computed, and indeed until recently the data have been insufficient to obtain any reliable approximate period. I have measured this pair lately with the large refractor, and with the new position



$O\Sigma$ 285.

$O\Sigma$ 285.

R. A. $14^h\ 40^m\ 59^s$
Decl. $+42^\circ\ 53'$

1891.285	348°.6	0".22	7.0 . . . 7.0	36
.304	347.7	0.25	. . .	36
.326	349.7	0.24	7.0 . . . 7.2	36
1891.30	348.7	0.24	7.0 . . . 7.1	
1892.186	159.8	0.24	8.0 . . . 8.1	36
.362	161.1	0.15	. . .	36
.364	165.7	0.24	8.0 . . . 8.2	36
1892.30	162.2	0.21	8.0 . . . 8.1	

there should be no difficulty in getting a provisional period and a fairly accurate representation of the apparent orbit.

The following is a complete list of the measures to the present time:

1845.80	72°.2	0".61	$O\Sigma$	3 n
1847.96	72.2	0.42	Ma	3 n
1852.69	60.6	0.45	Ma	1 n
1852.74	57.8	0.50	Ma	4 n
1855.84	53.9	0.51	$O\Sigma$	3 n
1857.50	65.5	0.40	Se	1 n
1881.50	Round or doubtful.		β	

1883.84	78°.3	0".22	En	5 n
1887.60	202.2	0.24	Sp	4 n
1891.30	168.7	0.24	β	3 n
1892.30	162.2	0.21	β	3 n

In laying down these observations, as shown on the accompanying diagram, for a graphical determination of the period, I have used a mean of the first two measures, and have rejected the single measure by SECCHI in 1857, the angle of which is obviously much too large.

From this ellipse we have the following:

Period	72.7 years.
Maximum distance (1853)	0.55"
Minimum distance (1881)	0.20
Major axis (55°)	0.78
Minor axis	0.50

The distance is now increasing, and in a few years it will be comparatively easy.

This pair is never really single, and should be measurable in all parts of its orbit with a large refractor. It will be noticed that at the time I found it doubtful in 1881 the distance was minimum, and unless the occasion was very favorable, a distance of 0".2 might be easily overlooked even with the Chicago refractor of 18½ inches. In April, 1876, I examined this with my 6-inch telescope, and noted "certainly a slight elongation in about 350°, but very close and difficult." At this time the distance must have been 0".3, and therefore well within the reach of that instrument under suitable conditions. For some years this pair should be regularly measured. A more accurate period can then be determined, together with the other elements of the orbit.

The star is B.A.C. 4885 (= P XIV 182).

β 106. μ Librae.

R. A. $14^h\ 42^m\ 45^s$
Decl. $-13°\ 39'$

A and B.

1889.378	342°.7	1".53	5.0 . . . 6.0	36
.383	340.0	1.67	. . .	36
.386	339.2	1.64	. . .	36
1889.38	340.6	1.61	. . .	

A and C.

1889.383	283°.1	18".25	. . 15.0	36
.386	284.3	18.41	. . 14.0	36
1889.38	283.7	18.33	. . 14.5	

A and D.

1889.378	185°.8	25".39	. . 13.5	36
.383	185.4	26.29	. . 13.5	36
.386	185.2	26.21	. . 14.0	36
1889.38	185.5	25.96	. . 13.9	

A and E.

1889.378	233°.0	27".28	. . 13.0	36
.383	232.5	27.04	. . 13.0	36
.386	232.1	27.26	. . 12.5	36
1889.38	232.5	27.19	. . 12.8	

The faint star C is now noted for the first time. There is probably slow direct motion in the close pair. There are two other faint stars in the direction of 74°.7 and 56°.5, respectively, a little farther than E.

β 31.

R. A. $14^h\ 46^m\ 59^s$
Decl. $+19°\ 13'$

A and B.

1890.340	190°.8	1".33	8.3 . . 9.5	36
.356	191.1	1.40	8.5 . . 10.0	36
.364	188.9	1.46	8.3 . . 9.7	36
1890.35	190.3	1.40	8.4 . . 9.7	

A and C.

1890.340	162°.1	9".13	. . 12.0	36
.356	162.2	8.95	. . 12.5	36
.364	163.8	9.00	. . 12.0	36
1890.35	162.7	9.03	. . 12.2	

β 347. Centauri 330.

R. A. $14^h\ 47^m\ 18^s$
Decl. $-32°\ 49'$

A and B.

1889.444	320°.5	12".79	6.0 . . 10.0	12
.447	321.0	13.04	6.5 . . 10.5	12
.465	320.4	13.20	7.0 . . 11.0	12
1889.45	320.6	13.01	6.5 . . 10.5	

A and C.

1889.444	242°.9	58".42	. . 9.5	12
.447	243.5	58.41	. . 10.0	12
.465	242.9	58.55	. . 10.0	12
1889.45	243.1	58.46	. . . 9.8	

No other measures.

β 942.

R. A. 14h 47m 29s
Decl. + 0° 2′

1892.263	192°.7	1″.39	9.0 . . . 9.2	36
.269	193.4	1.22	9.0 . . . 9.2	36
.362	187.4	1.18	9.5 . . . 9.6	36
1892.30	191.2	1.26	9.2 . . . 9.3	

β 239. 59 Hydrae.

R. A. 14h 51m 33s
Decl. — 27° 10′

1889.430	309°.0	0″.78	6.0 . . . 6.1	12
.436	315.2	0.99	5.5 . . . 5.5	36
.438	310.1	0.81	6.0 . . . 6.2	36
1889.44	311.4	0.86	5.8 . . . 5.9	

Very little, if any, change, although some of the measures are discordant.

β 348. 2 Serpentis.

R. A. 14h 55m 40s
Decl. + 0° 20′

1889.302	121°.3	0″.80	6.0 . . . 6.7	36
.312	116.8	0.72	Poor seeing	36
1889.31	119.0	0.76	6.0 . . . 6.7	

Σ 3091.

R. A. 15h 9m 43s
Decl. — 4° 26′

1890.375	46°.7	0″.33	. . .	36
.406	46.8	0.36	. . .	36
1890.39	46.8	0.35	. . .	

The measures of this pair are discordant, and perhaps, on the whole, do not show much change in the angle, but the distance for the last thirty years has been less than it was at the time of Σ, and probably about the same as it is now.

Σ 1926.

R. A. 15h 10m 23s
Decl. + 38° 45′

1889.288	258°.0	1″.29	7.0 . . . 9.0	36
.389	256.8	0.96	8.0 . . . 9.5	12
.392	258.2	1.05	8.0 . . . 9.0	12
1889.35	257.7	1.10	7.7 . . . 9.2	

Some change in distance.

β 943.

R. A. 15h 12m 16s
Decl. + 1° 23′

1889.296	92°.1	2″.51	6.0 . . 11.8	36
.302	92.8	2.70	6.0 . . 12.0	36
.312	93.1	2.67	6.5 . . 13.0	36
1889.30	92.7	2.63	6.2 . . 12.3	

Apparently without change.

1879.70	92°.5	2″.30	β	4 n

β 32. 6 Serpentis.

R. A. 15h 14m 54s
Decl. + 1° 9′

1889.296	19°.6	2″.51	5.5 . . 10.0	36
.302	15.0	2.45	6.0 . . 10.0	36
.312	19.1	2.36	6.0 . . 10.0	36
1889.30	17.9	2.44	5.8 . . 10.0	

There may be a little increase in the angle.

1875.43	13°.2	2″.28	Δ	4 n
1885.49	14.1	2.27	Tarrant	3 n

β 944.

R. A. 15h 25m 34s
Decl. + 48° 8′

1891.217	126°.3	11″.08	6.8 . . 11.5	36
.274	126.4	11.02	6.7 . . 12.5	36
.282	127.3	10.83	6.5 . . 11.8	36
1891.26	126.7	10.98	6.7 . . 11.9	

β 945.

R. A. 15h 26m 9s
Decl. + 57° 51′

1891.419	25°.7	15″.98	6.0 . . 12.0	36
.455	25.4	15.80	6.7 . . 11.5	36
1891.42	25.5	15.89	6.3 . . 11.7	

Considerable change in angle and distance. This corresponds to the proper motion of the principal star, which is 0″.304 in 297°.4.

β 121. B.A.C. 5163.

R. A. 15h 32m 20s
Decl. — 27° 15′

1889.447	276.°9	1.″48	7.5 . . . 7.7	12
.468	276.7	1.49	8.7 . . . 8.7	12
.505	278.8	1.37	8.5 . . . 8.5	12
1889.47	277.5	1.45	8.2 . . . 8.2	

Probably unchanged.

β 619. Serpentis 55.

R. A. 15h 37m 34s
Decl. + 14° 3′

1891.274	360.°4	0.″46	6.8 . . . 7.5	36
.301	358.4	0.65	7.0 . . . 8.0	36
.304	360.5	0.66	6.8 . . . 7.5	36
1891.29	359.8	0.59	6.9 . . . 7.7	

Without change.

β 620.

R. A. 15h 38m 54s
Decl. — 27° 41′

AB and C.

1891.487	214.°0	50.″74	7.0 . . . 9.2	12
.490	214.2	50.85	7.6 . . . 9.0	12
.493	214.5	50.81	7.0 . . . 8.7	12
1891.49	214.2	50.80	7.2 . . . 9.0	
1892.403	214.7	50.80	. . . 8.3	36
.406	214.4	50.72	. . . 8.7	36
.422	214.3	50.69	. . . 8.7	36
1892.41	214.5	50.74	. . . 8.6	

A and B.

1892.403	153.°0	0.″54	7.8 . . . 8.0	36
.406	153.1	0.53	7.8 . . . 8.0	36
.422	157.2	0.44	7.5 . . . 7.6	36
1892.41	154.4	0.50	7.7 . . . 7.9	

The wide pair is *H* 4803.

β 946. B.A.C. 5248.

R. A. 15h 44m 44s
Decl. + 55° 45′

1891.274	151.°5	1.″45	6.0 . . 11.5	36
.282	145.4	1.36	5.7 . . 11.0	36
.285	149.9	1.47	5.5 . . 12.0	36
1891.28	148.9	1.43	5.7 . . 11.5	

β 621.

R. A. 15h 45m 54s
Decl. + 45° 7′

1891.285	61.°2	0.″55	8.3 . . 8.8	36
.304	61.2	0.64	8.0 . . 10.0	36
.362	62.1	0.52	8.0 . . 9.0	36
1891.32	62.2	0.57	8.1 . . 9.3	

Σ 1989. π² Ursae Majoris.

R. A. 15h 46m 13s
Decl. + 80° 22′

1892.153	358.°2	0.″24	6.0 . . . 7.0	36
.364	365.2	0.28	6.0 . . . 7.0	36
.383	367.3	0.21	6.0 . . . 7.0	36
1892.30	363.6	0.24	6.0 . . . 7.0	

But few measures have been made of this pair, although it is in a position to be observed at all observatories in the northern hemisphere on every night of the year. It is always moderately difficult with ordinary refractors, and the distance is still slowly decreasing. It is certainly a binary, but the period must be very long, as the angular motion in sixty years has been but about 20°. With so small an arc it would, of course, be useless to attempt to obtain even an approximate period. It should be measured more frequently than heretofore to furnish the requisite data. It is probable that for some time to come the larger refractors will be necessary for this work. The following are all the measures since the discovery of this pair by STRUVE:

1832.68	24.°1	0.″71	Σ	3 n
1836.76	23.9	0.53	Σ	3 n
1840.95	28.1	0.70	*O*Σ	3 n
1841.46	23.0	0.85	Ma	1 n
1858.59	21.1	0.60	Se	2 n
1881.43	14.9	0.49	β	4 n
1884.20	2.5	0.33	En	6 n
1892.30	3.6	0.24	β	3 n

The magnitudes of the components are 7.1 and 8.1 in STRUVE.

β 622. π Scorpii.

R. A. 15h 51m 36s
Decl. — 25° 46′

1892.362	131.°8	50.″48	. . 13.0	36
.403	132.0	50.26	. . 11.8	36
.406	132.9	50.48	. . 12.0	36
1892.39	132.2	50.41	. . 12.3	

H 1281.

R. A. $15^h\ 50^m\ 17^s$
Decl. $-15^\circ\ 41'$

1890.364	229°.8	35″.12	6.5 . . 12.0	36

HERSCHEL called the companion 20th magnitude, and gave the angle and distance (estimated) 215°: 18″. There are no other measures. I could not see the small star on two occasions in 1875 with the 6-inch. HERSCHEL'S 18 to 20 magnitudes, as a rule, represent stars which would be called about 12 in the scale used here.

β 37.

R. A. $15^h\ 55^m\ 15^s$
Decl. $-24^\circ\ 15'$

1891.487	43°.9	2″.64	9.0 . . 10.0	12
.493	45.3	3.02	8.8 . . 9.1	12
.496	44.5	2.42	8.2 . . 9.0	12
1891.49	44.6	2.69	8.7 . . . 9.4	

β 38.

R. A. $15^h\ 55^m\ 39^s$
Decl. $-24^\circ\ 41'$

1891.487	353°.3	4″.52	7.5 . . 8.5	12
.490	354.4	4.47	8.0 . . 10.5	12
.493	351.0	4.57	7.6 . . 8.7	12
1891.49	352.9	4.52	7.7 . . 9.2	

β 947. β Scorpii.

R. A. $15^h\ 58^m\ 28^s$
Decl. $-19^\circ\ 29'$

A and B.

1889.383	91°.6	0″.88	. . 11.0	36
.397	95.5	1.13	. . 11.0	36
.422	94.9	0.89	. . 11.0	36
.430	89.9	0.86	. . 10.5	12
.438	97.4	0.94	. . 10.5	36
1889.41	93.9	0.94	. . 10.8	
1892.403	92.7	1.03	. . 9.5	36
.406	98.5	1.00	. .	36
.422	96.2	1.06	. .	36
1892.41	95.8	1.03	. .	

This will certainly prove to be a physical pair, but the change thus far, if any, is very slow:

1880.06	88°.4	0″.91	β	6 n
1881.50	92.7	0.96	β	3 n

β 811.

R. A. $16^h\ 0^m\ 4^s$
Decl. $+22^\circ\ 30'$

1889.473	220°.2	3″.72	8.0 . . 11.0	36
.479	221.5	3.59	7.5 . . 10.5	36
.534	220.3	3.78	8.0 . . 11.0	36
1889.49	220.7	3.70	7.8 . . 10.8	

β 355.

R. A. $16^h\ 4^m\ 14^s$
Decl. $+45^\circ\ 42'$

1892.186	279°.7	0″.36	7.8 . . . 9.5	36
.263	275.3	0.36	8.0 . . . 9.0	36
.363	277.3	0.47	8.0 . . . 9.0	36
1892.27	277.4	0.40	7.9 . . . 9.2	

There is a 13-m. star in the direction of 97°.3, and distant 12″.8.

β 40.

R. A. $16^h\ 4^m\ 29^s$
Decl. $-27^\circ\ 14'$

1891.471	352°.7	5″.08	8.5 . . . 9.5	12
.482	357.1	5.03	8.5 . . . 9.7	12
.487	356.1	5.01	8.3 . . . 8.8	12
.490	354.8	5.14	8.3 . . . 9.5	12
1891.48	355.2	5.07	8.4 . . . 9.4	

My first new pair in point of time.

β 1087. τ Coronae.

R. A. $16^h\ 4^m\ 35^s$
Decl. $+36^\circ\ 46'$

1890.280	168°.8	3″.03	. .	36
.334	168.5	3.32	. . 13.5	36
.340	167.5	3.02	. .	36
1890.32	168.3	3.12	. .	
1891.285	170.0	3.10	. . 14.5	36
.326	170.5	3.15	. . 14.0	36
.362	171.5	3.26	. . 14.0	36
1891.32	170.7	3.17	. . 14.2	
1892.381	169.5	3.07	. . 14.0	36
.383	169.7	2.91	. . 14.0	36
.386	170.5	3.31	. . 13.8	36
1892.38	169.9	3.10	. . 13.9	

The large star has a proper motion of 0″.347 in the direction of 348°.4. It is obvious, from the measures, that this movement belongs to the companion, and that the two form a physical system.

β 120. ν Scorpii.

R. A. 16h 5m 1s
Decl. — 19° 9′

A and B.

1889.430	1.4	0.83	...	12
.438	1.9	0.81	...	36
.465	0.2	0.75	...	12
1889.44	1.2	0.80	...	

Σ 2032. σ Coronae.

R. A. 16h 10m 12s
Decl. + 34° 10′

A and B.

1890.280	209.5	4.05	...	36
.337	207.1	3.99	...	36
.383	206.9	4.20	...	36
1890.33	207.8	4.08	...	

A and C.

1890.280	214.7	12.57	...	36
.337	211.4	12.29	...	36
.383	213.5	12.80	...	36
1890.33	213.2	12.55	...	

The change in the small star is due to the proper motion of AB.

β 624.

R. A. 16h 15m 41s
Decl. — 22° 50′

1891.487	323.4	1.10	8.0 . . 9.0	12
.490	322.6	1.25	8.2 . . 10.0	12
.496	319.5	1.19	8.2 . . 10.5	12
.529	324.5	1.20	8.0 . . 10.0	12
.531	321.7	1.12	8.2 . . 11.0	12
.534	321.7	1.16	8.0 . . 10.7	12
1891.51	322.2	1.17	8.1 . . 10.2	

β 1198. τ Herculis.

R. A. 16h 16m 8s
Decl. + 46° 36′

1892.403	145.6	6.70	4.5 . . 14.0	36

There is an error of 180° in the position-angle of my first measures. It should read:

1890.35	145.3	6.57		4 n

Sh. 228. ρ Ophiuchi.

R. A. 16h 18m 23s
Decl. — 23° 10′

A and B.

1889.386	354.1	3.34	...	36
.389	355.4	3.46	5.5 . . . 5.8	12
.392	355.5	3.43	5.5 . . . 5.7	12
1889.39	355.0	3.41	5.5 . . . 5.8	

A and C.

1889.389	359.7	150.98	. . . 8.0	12
.392	360.0	151.41	. . . 8.0	12
1889.39	359.8	151.15	. . . 8.0	

A and D.

1889.386	253.3	156.05	...	36
.389	252.8	156.39	. . . 8.0	12
.392	252.8	156.84	. . . 8.0	12
1889.39	253.0	156.43	. . . 8.0	

The distant star D is a close pair, and will be found in the list of new pairs.

β 950.

R. A. 16h 18m 44s
Decl. — 9° 35′

1892.362	356.5	1.00	8.3 . . . 9.5	36
.364	353.5	1.09	8.2 . . . 8.8	36
.403	353.5	1.12	8.0 . . . 8.7	36
1892.37	354.5	1.07	8.2 . . . 9.0	

β 951.

R. A. 16h 18m 59s
Decl. + 33° 40′

1892.186	53.3	0.87	8.3 . . . 9.0	36
.263	55.6	0.90	8.0 . . . 8.7	36
.269	57.4	0.95	8.0 . . . 9.3	36
1892.24	55.4	0.91	8.1 . . . 9.0	

β 625. ω Herculis.

R. A. 16h 19m 52s
Decl. + 14° 19′

A and B.

1890.375	178.2	1.78	. . 12.0	36
.383	178.3	1.74	. . 11.5	36
1890.38	178.2	1.76	. . 11.7	

A and C.

1890.364	103°.8	33".32	. . 12.0	36
.375	103.4	33.50	. . 12.5	36
.388	103.3	33.40	. .	36
1890.37	103.5	33.41	. . 12.2	

These are the only other measures:

1879.21	176°.8	1".91	β	3 n
1879.05	103.5	33.89	β	4 n

β 814.

R. A. 16h 23m 9s
Decl. + 40° 9′

1891.285	323°.8	0".33	8.5 . . . 8.5	36
.326	324.7	0.35	8.3 . . . 8.3	36
.331	323.7	0.24	. . .	36
1891.32	324.1	0.31	8.4 . . . 8.4	

β 815.

R. A. 16h 23m 16s
Decl. + 43° 11′

1889.425	343°.4	7".63	8.5 . . 10.0	36
.430	342.4	7.68	8.5 . . 11.8	12
.436	344.1	7.72	8.5 . . 10.5	36
1889.43	343.3	7.68	8.5 . . 10.8	
1890.326	344.0	7.93	. .	36
.331	344.7	7.62	8.5 . . 10.0	36
.337	344.6	7.72	8.3 . . 9.5	36
1890.33	344.4	7.76	8.4 . . 9.7	

The change in this pair is due to proper motion, which measures show is about 0".17 per annum.

1881.30	348°.4	6".42	β	3 n
1886.40	344.5	7.28	En	6 n

β 626. φ Ophiuchi.

R. A. 16h 24m 16s
Decl. — 16° 21′

1892.403	35°.3	33".40	. . 13.0	36
.406	36.3	33.40	. . 13.0	36
1892.40	35.8	33.40	. . 13.0	

Copeland.

R. A. 16h 26m 27s
Decl. + 60° 57′

1892.364	75°.3	1".20	8.5 . . . 9.0	36
.378	77.2	1.16	8.7 . . . 9.0	12
.395	74.8	1.17	8.5 . . . 9.0	12
1892.38	75.8	1.18	8.6 . . . 9.0	

Discovered by COPELAND in observing a comet. (*Copernicus*, III, 131.)

β 818. 32 Herculis.

R. A. 16h 28m 50s
Decl. + 30° 45′

1889.244	34°.4	3".55	6.0 . . 13.5	36
.293	31.0	3.37	6.0 . . 13.0	36
.312	33.2	4.01	6.0 . . 14.0	36
1889.28	32.9	3.64	6.0 . . 13.5	

The companion, with the 15½-inch refractor of the WASHBURN Observatory, with which it was discovered, was of the last degree of difficulty, and it is not prominent even with this telescope. The first measures are:

1881.48	33°.5	3".29	β	3 n

β 356.

R. A. 16h 29m 51s
Decl. + 69° 12′

1892.304	119°.1	6".93	9.0 . . 12.0	36
.362	118.5	7.48	8.3 . . 11.5	36
.364	119.0	7.11	8.5 . . 11.0	36
1892.34	118.9	7.17	8.6 . . 11.5	

β 952.

R. A. 16h 31m 9s
Decl. + 37° 9′

A and B.

1892.186	146°.0	3".88	8.3 . . . 9.5	36
.263	146.2	4.03	8.0 . . . 9.0	36
.269	146.2	3.96	8.0 . . . 9.5	36
1892.24	146.1	3.96	8.1 . . . 9.3	

B and C.

1892.186	243.0	2.21	. . 14.0	36
.263	244.5	2.17	. . 13.5	36
.269	245.3	2.01	. . 13.5	36
1892.24	244.3	2.13	. . 13.7	

The faint star has not been seen before.

β 820.

R. A. 16h 33m 9s
Decl. — 2° 52′

1892.362	237.5	4.17	8.0 . . 10.0	36
.364	237.7	4.46	8.0 . . 10.3	36
.406	236.9	4.20	7.3 . . 10.8	36
1892.38	237.4	4.28	7.8 . . 10.4	

β 42.

R. A. 16h 35m 20s
Decl. + 29° 15′

1892.304	41.4	7.09	9.0 . . . 9.3	36
.362	42.4	7.48	8.7 . . . 9.0	36
1892.33	41.9	7.28	8.8 . . . 9.1	

β 953.

R. A. 16h 37m 49s
Decl. + 70° 2′

1891.419	302.8	0.12	7.8 . . . 8.5	36
1892.383	297.0	0.17	8.0 . . . 8.5	36
.386	301.2	0.19	8.0 . . . 8.6	36
.400	296.0	0.19	. . .	36

A most interesting binary, and now a very difficult pair. The mean of the last set of measures is:

1892.39	298.1	0.18	3 n

β 43.

R. A. 16h 42m 18s
Decl. + 2° 57′

1892.364	246.1	1.05	8.3 . . . 8.4	36
.406	243.9	0.98	8.2 . . . 8.2	36
1892.38	245.0	1.01	8.2 . . . 8.3	

β 627. 52 Herculis.

R. A. 16h 45m 43s
Decl. + 46° 12′

1892.186	317.3	1.62	5.0 . . . 9.5	36
.263	319.3	1.60	5.0 . . . 8.5	36
.269	319.4	1.63	5.0 . . . 9.2	36
1892.24	318.7	1.62	5.0 . . . 9.1	

β 241.

R. A. 16h 48m 24s
Decl. — 21° 22′

1890.452	157.3	0.68	7.0 . . . 7.0	12
.458	162.2	0.83	7.5 . . . 7.5	36
.463	160.5	0.75	. . .	36
1890.46	160.0	0.75	7.2 . . . 7.2	

Change is doubtful.

Kustner 1.

R. A. 16h 48m 27s
Decl. + 77° 43′

1889.173	187.9	2.70	7.3 . . 10.5	12
.227	188.9	2.70	7.0 . . 10.0	36
.247	191.1	2.76	6.8 . . 10.5	36
1889.21	189.3	2.72	7.0 . . 10.3	

Discovered by KUSTNER with the Berlin Meridian Circle (A. N. 2756). There are no published measures of this pair.

β 1117. 24 Ophiuchi.

R. A. 16h 49m 34s
Decl. — 22° 57′

1890.406	262.7	0.63	. . .	36
.452	265.2	0.45	. . .	36
.479	264.9	0.65	. . .	36
1890.45	264.3	0.58	. . .	

There seems to be no change since the measures of last year.

β 954. 54 Herculis.

R. A. 16h 50m 59s
Decl. + 18° 38′

1891.225	176.7	2.51	. . 12.0	36
.282	171.0	2.52	5.5 . . 12.5	36
.304	176.9	2.66	5.5 . . 13.0	36
1891.27	174.9	2.56	5.5 . . 12.5	

Σ 2118. 20 Draconis.

R. A. $16^h\ 55^m\ 49^s$
Decl. $+65^\circ\ 13'$

	°	″			
1889.403	140.8	0.10	est.	...	36
.463	136.8	0.10	5.5	... 6.0	36
.499	144.4	0.14		...	36
1889.45	140.7	0.11		...	
1891.285	122.6	0.12		...	36
.326	128.3	0.09		...	36
.389	125.9	0.12		...	36
1891.33	125.6	0.11		...	
1892.383	118.0	0.11		...	36
.386	114.0	0.14		...	36
.400	123.0	0.12		...	36
1892.39	118.3	0.12		...	

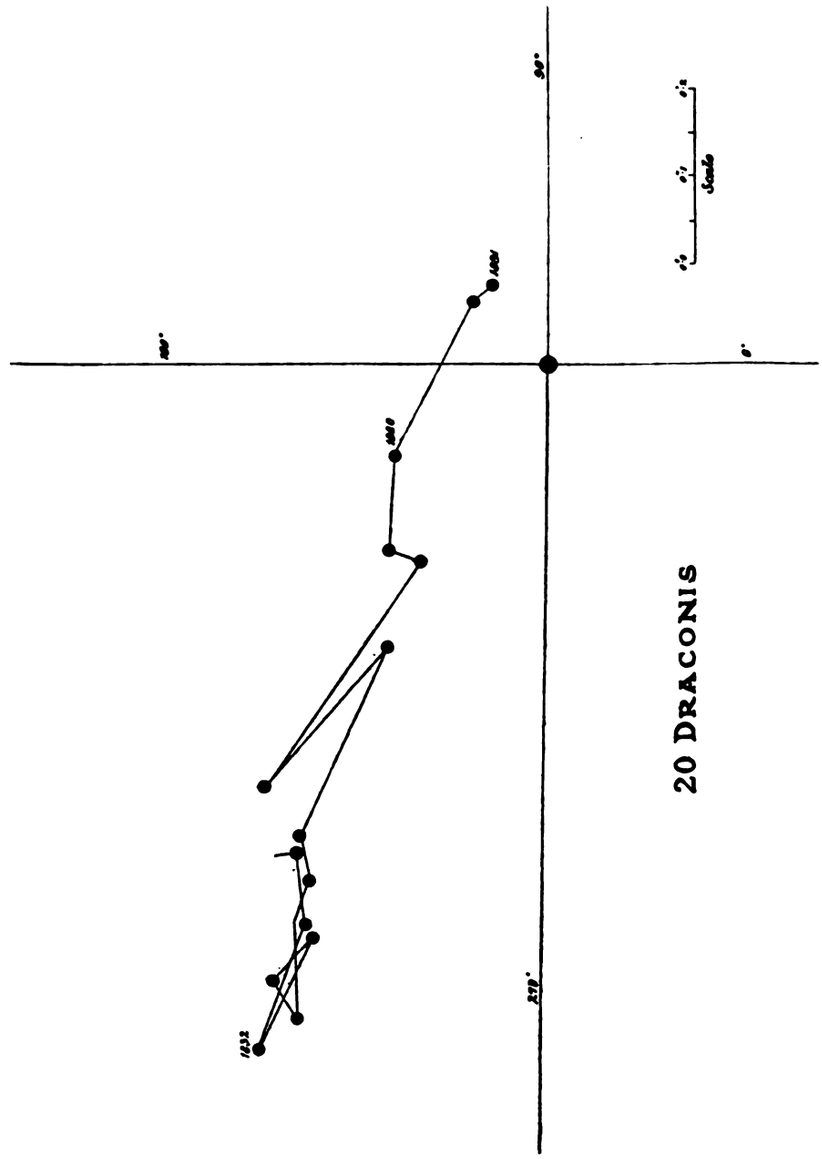
[From *Monthly Notices*, June, 1891.]

Although this double star (Σ 2118) was discovered by WILLIAM HERSCHEL more than one hundred years ago, it has received but little attention from observers in recent years. Within the last thirty years it has been close and rather difficult, but before 1860 it was easily measurable with almost any telescope. During this period the distance was slowly diminishing, while the angle remained nearly constant. For the past ten years it has been too close to be seen with any but the most powerful refractors.

I have collected all the observations with the micrometer which have any value, and give them below in chronological order for convenience in future investigations. I have omitted all negative results where the star was noted as "round," "single," "elongated," etc., since it is evident that it has never been really single, and the failures to see it were due to insufficient optical power, or unfavorable atmospheric conditions.

	°	″		
1783.26	251.5	...	*H*	1 n
1830.32	242.6	0.63	*H*	1 n
1831.37	246.1	0.70	*H*	1 n
1832.30	246.4	0.85	Σ	5 n
1834.57	252.0	...	Da	1 n
1836.75	247.0	0.71	Σ	3 n
1840.77	242.9	...	Da	1 n
1841.24	245.3	0.77	*O*Σ	3 n
1843.32	248.4	0.80	Ma	1 n
1847.71	243.3	...	Mh	2 n
1847.97	244.6	0.65	Ma	2 n
1854.81	241.7	0.61	Da	3 n
1857.35	240.1	0.37	Se	3 n
1859.67	235.7	0.58	*O*Σ	2 n
1872.42	238.0	0.27	*O*Σ	1 n
1874.73	224.0	...	N	1 n
1877.13	229.4	0.28	De	3 n
1880.82	211.3	0.20	*β*	4 n
1889.45	140.7	0.11	*β*	3 n
1891.33	125.6	0.11	*β*	3 n
1892.39	118.3	0.12	*β*	3 n

All of these measures are laid down accurately to scale on the accompanying diagram, except the observations of HERSCHEL, DAWES, MITCHELL, and NEWCOMB, where the distance was not measured. It is obvious at a glance that these positions taken together furnish no evidence whatever of orbital motion so far as their direction is concerned. A straight line will better represent them than any curve. The chances are enormously in favor of this being a physical system, and I have no doubt that will be shown to be the fact, but at present it is more a matter of probability than anything else. If these stars were a considerable distance apart, there would be hardly any doubt that the relative movement was due to proper motion. The two components, as one star, have a proper motion of 0″.227 in the direction of 79°.3, and this angle corresponds very nearly to the motion of B with respect to A. A line drawn through the observed positions of B, making an angle of 73° with the meridian, will represent the measures as closely as they are ever represented by a line of any character in stars of this class. To be sure the later observations appear to indicate an accelerated motion, as would be expected if the path is a very elongated ellipse, but the errors in the series generally are so large it is impossible to deduce any harmonious result. Taking the mean of STRUVE'S measures to represent the place of B at the mean date (1834.5), the movement of that star to 1891.3 is 0″.86, giving an average of 0″.015 per annum. If it is moving around the primary, as is most probably the case, it is evident that the apparent ellipse is one of extraordinary



S.W.Burnham, del.

elongation. There is nothing like it known in the heavens. The period is certainly several hundred years. In one or two years more, the measures will definitely settle the character of this motion. It will probably be a difficult object for some time to come, and should be carefully measured by observers having sufficiently powerful instruments. It will be noticed that the same grouping of positions, and apparent reversal of motion, occurs here in the first eight measures, which, I have shown elsewhere, is found in the measured places of all slow-moving pairs.

β 955.

R. A. $16^h\ 55^m\ 50^s$
Decl. $+\ 82^\circ\ 3'$

	°	″			
1891.301	353.0	0.60	8.0 . .	9.3	36
.326	351.8	0.76	8.2 . .	8.5	36
.329	351.2	0.57	8.2 . .	10.0	36
1891.32	352.0	0.64	8.1 . .	9.3	

β 357.

R. A. $16^h\ 59^m\ 52^s$
Decl. $+\ 10^\circ\ 43'$

	°	″			
1891.487	304.6	0.91	8.3 . .	8.9	12
.490	302.9	1.26	8.5 . .	9.3	12
.493	299.9	1.08	8.5 . .	10.0	12
1891.49	302.5	1.08	8.4 . .	9.4	

The angle is increasing.

Σ 2120.

R. A. $17^h\ 0^m\ 0^s$
Decl. $+\ 28^\circ\ 15'$

1890.534 Large star not double. 36

The principal star of this pair was thought to be double by PERROTIN in 1883.

β 823.

R. A. $17^h\ 0^m\ 29^s$
Decl. $+\ 0^\circ\ 49'$

	°	″			
1889.468	0.9	1.05	9.0 . .	10.0	12
.473	359.7	1.25	8.5 . .	9.0	36
.508	358.8	1.22	8.5 . .	9.5	12
1889.48	359.8	1.17	8.7 . .	9.5	

The earlier measures are:

	°	″		
1881.39	353.9	1.04	β	4 n

β 1088. μ Draconis.

R. A. $17^h\ 2^m\ 51^s$
Decl. $+\ 54^\circ\ 38'$

B and C.

	°	″			
1891.285	189.3	12.41	. .	13.0	36
.301	189.3	12.00	. .	13.5	36
.326	190.6	12.19	. .	13.5	36
1891.30	189.7	12.20	. .	13.3	
1892.323	191.2	11.87	. .	13.5	36
.383	191.4	12.28	. .	13.5	36
.386	191.3	12.18	. .	14.0	36
1892.36	191.3	12.11	. .	13.7	

The new star is probably moving with the bright components.

β 1118. η Ophiuchi.

R. A. $17^h\ 3^m\ 30^s$
Decl. $-\ 15^\circ\ 34'$

	°	″		
1890.406	268.8	0.30	. . .	36
.447	271.6	0.41	. . .	36
.452	271.2	0.42	. . .	12
.496	272.9	0.40	. . .	36
1890.45	271.1	0.38	. . .	
1892.364	274.0	0.29	. . .	36
.422	270.0	0.44	. . .	36
.425	266.1	0.35	. . .	36
1892.40	270.0	0.36	. . .	

The angle is slowly decreasing, with little change in the distance.

β 124.

R. A. $17^h\ 4^m\ 0^s$
Decl. $-\ 0^\circ\ 37'$

	°	″			
1891.709	269.0	1.01	7.5 . .	11.5	36
.711	264.6	0.87	7.0 . .	11.0	36
1891.71	266.8	0.94	7.2 . .	11.2	

β 125.

R. A. $17^h\ 4^m\ 43^s$
Decl. $-\ 26^\circ\ 53'$

	°	″			
1889.447	63.6	1.38	7.6 . .	9.0	12
.468	56.4	1.60	8.0 . .	10.0	12
.505	61.9	1.47	8.0 . .	11.0	12
1889.47	61.3	1.48	7.9 . .	10.0	

Change uncertain.

Barnard.

R. A. $17^h\ 7^m\ 38^s$
Decl. $-\ 8^\circ\ 16'$

	°	″			
1891.452	153.2	2.16	8.3 . .	10.8	36
.487	156.5	2.13	8.4 . .	13.0	12
.502	154.5	2.19	8.0 . .	11.0	36
1892.48	154.7	2.16	8.2 . .	11.6	

Discovered by Mr. E. E. BARNARD with the 12-inch.

β 282.

R. A. 17h 8m 29s
Decl. — 14° 27′

1889.406	152°.4	4″.25	6.0 . . 11.0	36
.422	152.0	4.33	6.5 . . 11.0	36
.430	151.2	4.35	6.5 . . 12.0	12
1889.42	151.9	4.31	6.3 . . 11.3	

No sensible change in this pair.

β 957.

R. A. 17h 8m 57s
Decl. — 10° 10′

1889.473	201°.9	0″.45	8.0 . . . 8.2	36
.512	202.8	0.46	8.3 . . . 8.5	36
.515	200.3	0.51	8.3 . . . 8.5	36
1889.50	201.7	0.47	8.2 . . . 8.4	

The first measures are:

1880.16	23°.6	0″.58	β	3 n	7.9 . . 7.9	

α Herculis.

R. A. 17h 9m 10s
Decl. + 14° 32′

A and C.

1888.671	333°.9	23″.97	. . 15.0	36
1889.312	337.7	23.12	. . 15.0	36
1888.99	335.8	23.54	. . 15.0	

A faint star noted by Mr. ALVAN G. CLARK. It has not been measured before.

A and D.

1890.422	39°.1	84″.91	. . 10.5	36
.447	38.9	84.60	. . 10.5	36
.458	39.1	84.87	. . 10.8	36
1890.44	39.0	84.79	. . 10.6	

β 958.

R. A. 17h 9m 25s
Decl. — 19° 12′

1892.364	215°.7	1″.43	8.5 . . . 9.0	36
.381	218.0	1.27	8.3 . . . 8.5	36
.425	217.1	1.44	8.2 . . . 8.6	36
1892.39	216.9	1.38	8.3 . . . 8.7	

β 416. B.A.C. 5825.

R. A. 17h 10m 46s
Decl. — 34° 51′

A and B.

1888.717	147°.5	1″.88	6.0 . . . 7.5	12
1889.392	135.0	1.39	6.0 . . . 6.5	12
.447	132.0	1.50	6.2 . . . 8.0	12
.465	135.3	1.17	7.0 . . . 8.0	12
1889.43	134.1	1.35	6.4 . . . 7.5	
1891.529	82.1	0.53	6.5 . . . 7.2	12
.531	80.1	0.53	6.5 . . . 7.2	12
.534	81.3	0.48	7.5 . . . 8.5	12
1891.53	82.3	0.51	6.9 . . . 7.6	
1892.362	18.9	0.62	6.0 . . . 8.0	36
.364	23.1	0.50	6.0 . . . 8.5	36
.386	30.8	0.64	. . .	36
.400	24.9	0.58	6.0 . . . 8.3	36
1892.38	24.4	0.58	6.0 . . . 8.3	

AB and C (= *H* 4935).

1889.392	128°.4	30″.80	. . 11.0	12
.447	128.1	30.75	. . 10.0	12
.465	129.4	31.55	. . 10.5	12
1889.43	128.6	31.03	. . 10.5	
1891.526	128.2	30.39	. . 11.5	12
.529	129.4	30.27	. . 12.0	12
.531	128.9	30.91	. . 12.5	12
1891.53	128.8	30.52	. . 12.0	
1892.362	129.6	30.55	. .	36
.364	129.2	30.55	. . 12.0	36
1892.36	129.4	30.55	. .	

[From *Sidereal Messenger*, December, 1891.]

The wide double star, *H* 4935, was found by HERSCHEL in 1837, at the Cape of Good Hope, and entered in the catalogue of double stars in the *Cape Observations*. No distance is given, and the angle is stated to be estimated from a diagram. In 1876, while observing with the 6-inch refractor, I came across this pair, and at once saw that the principal star was also double. At that time it was a very easy pair, even at the low altitude of this star in the latitude of Chicago. It was not measured at this time, but the angle and distance were carefully estimated, and these estimates are of some value in showing the rapid

motion which has taken place during the last fifteen years. It should be remarked, concerning my measures given in A. N. 2957, that the result is a mean of four nights' measures. One of these measures was made in 1888 and three in 1889. The first made the position-angle some 13° more than the last three. This difference was assumed to be due to errors of observation, and therefore the mean was taken of all the measures. It is now evident that this difference was real, and due to the rapid change in the relative positions of the stars; and that the measures of those years should be given separately. The following are all the measures to this time:

A and B.

1876.52	240°.±	1".8±	6.0 . . . 8.5	β	1 n
1877.53	222.6	1.80	7.0 . . . 8.0	Cin⁴	1 n
1877.64	224.4	1.77	7.0 . . . 9.0	Russell	1 n
1888.72	147.5	1.88	6.0 . . . 7.5	β	1 n
1889.43	134.1	1.35	6.4 . . . 7.5	β	3 n
1889.63	131.9	0.97	6.0 . . . 8.5	Pollock	1 n
1891.53	82.3	0.51	6.9 . . . 7.6	β	3 n
1892.38	24.4	0.58	6.0 . . . 8.3	β	4 n

It is obvious, from an inspection of these measures, laid down on paper to scale, that this change is not the result of proper motion; and it is equally certain that it is a binary of short period. A period derived from these measures would, perhaps, be too rough for any useful purpose, although the minimum time could be readily determined by the graphical method, but the measures of one year more should be sufficient to fix it with reasonable accuracy. The distance will probably decrease still further, and it may be too difficult for accurate measurements in this latitude. It was well enough seen this year for good measures, but a decrease in the distances of one or two tenths of a second would make it a very difficult pair here. It is unusual for so wide a pair as this, taking the average distance to this time, to have an orbital motion so rapid; and it suggests the possibility that this pair may be much nearer than most of the pairs having corresponding relative motions.

There seems to be no evidence of change in the place of the HERSCHEL star, but the distance is much too large to make it probable that any connection exists between this and the close pair. The measures are all of very recent date, but we have the estimated angle of HERSCHEL, which is in close agreement with the later measures.

A and C (= *H* 4935).

1837.	130°.±		. .	*H*	1 n
1876.	130.±		. . 10.0	β	1 n
1877.64	132.4		. .	Russell	1 n
1889.43	128.6	31".03	. . 10.5	β	3 n
1891.53	128.8	30.52	. . 12.0	β	3 n
1892.36	129.4	30.55	. . 12.0	β	2 n

This star is *Scorpii* 185 = B.A.C. 5825 = *Lacaille* 7215. The estimates of magnitude cover quite a wide range. In B.A.C. it is 6ᵐ; GOULD, 6.1; Washington Catalogue, 7.0; and STONE (Cape Catalogue), 7.6.

It is very desirable that observers in the southern hemisphere should follow the close pair, and measure it each year if possible.

126. P *XVII.*, 43.

R. A. 17ʰ 12ᵐ 54ˢ
Decl. — 17° 38′

A and B.

1892.362	262°.3	1".57	6.5 . . . 8.0	36
.364	261.8	1.72	6.0 . . . 9.0	36
.381	261.9	1.71	6.0 . . . 8.5	36
1892.37	262.0	1.67	6.2 . . . 8.5	

A and C.

1892.362	138°.6	11".59	. . 12.0	36
.364	139.3	11.54	. . 13.0	36
.381	138.7	11.65	. . 11.0	36
1892.37	138.9	11.59	. . 12.0	

Change doubtful.

β 45.

R. A. 17ʰ 13ᵐ 29ˢ
Decl. + 32° 37′

1892.400	289°.5	4".82	8.7 . . . 8.9	36
.403	290.1	5.15	8.5 . . . 8.7	36
1892.40	289.8	4.98	8.6 . . . 8.8	

Without change.

β 628.

R. A. 17ʰ 13ᵐ 55ˢ
Decl. + 32° 47′

1892.186	359°.8	0".56	8.3 . . 8.6	36
.362	356.7	0.44	8.8 . . 9.3	36
.364	359.2	0.55	9.0 . . 10.0	36
1892.30	358.6	0.52	8.7 . . . 9.3	

Change uncertain.

OΣ 327.

R. A. 17h 11m 53s
Decl. + 56° 16′

1891.285	302°.7	0″.29	8.0 . . . 8.2	36
.326	303.1	0.19	7.8 . . . 7.8	36
.389	300.9	0.22	8.0 . . . 8.1	36
1891.33	302.2	0.20	7.9 . . . 8.0	

Very few measures of this pair. It has generally be noted as single, or with a doubtful elongation.

β 629.

R. A. 17h 14m 7s
Decl. + 32° 11′

1891.282	343°.7	1″.08	8.5 . . . 9.0	36
.326	343.0	1.11	8.4 . . . 8.6	36
.331	344.7	0.84	8.5 . . . 8.7	36
1891.31	343.8	1.01	8.5 . . . 8.8	
1892.364	342.4	1.08	8.5 . . . 9.0	36
.400	344.3	0.96	8.3 . . . 8.6	36
.403	345.0	1.01	8.3 . . . 8.6	36
1892.39	343.9	1.02	8.4 . . . 8.7	

Very little change since 1878.

Swift.

R. A. 17h 15m 0s
Decl. + 53° 47′

1889.433	131°.0	0″.63	8.6 . . . 8.7	36
.436	133.3	0.50	9.0 . . . 9.1	36
.438	131.7	0.59	9.0 . . . 9.0	36
1889.43	132.0	0.57	8.9 . . . 9.0	

Discovered by Dr. LEWIS SWIFT. No other measures.

β 630.

R. A. 17h 15m 53s
Decl. + 32° 25′

1892.186	224°.2	1″.49	8.5 . . 9.5	36
.400	226.0	1.36	8.5 . . 9.0	36
.403	224.1	1.49	8.5 . . 10.3	36
1892.33	224.8	1.45	8.5 . . 9.6	

β 959. Ophiuchi 185.

R. A. 17h 16m 8s
Decl. + 5° 7′

1891.455	259°.4	3″.28	7.5 . . 11.0	36
.482	257.1	2.85	7.5 . . 12.0	12
.487	257.2	2.79	7.0 . . 11.5	12
.490	256.2	3.44	7.0 . . 12.5	12
.504	256.5	3.41	7.0 . . 11.5	36
1891.48	257.3	3.15	7.2 . . 11.7	

β 128. B.A.C. 5879.

R. A. 17h 19m 23s
Decl. — 26° 14′

1891.545	328°.7	4″.08	8.2 . . 9.5	12
.567	327.0	3.83	7.5 . . 10.7	12
.573	328.3	4.22	7.5 . . 10.7	12
1891.56	328.0	4.04	7.7 . . 10.3	

Σ 2173.

R. A. 17h 24m 14s
Decl. — 0° 58′

1890.630	No third star.	36
.633	No third star.	36

In 1883, WILSON, at Cincinnati, measured a third star C, 10m, 291°.0 : 7″ ±. As this has never been seen anywhere else, and is invisible now, it probably has no real existence. The following are measures of the Σ pair:

1891.567	338°.1	0″.93	. . .	12
.594	339.3	0.97	. . .	36
.597	341.6	0.89	. . .	36
1891.58	339.7	0.93	. . .	

β 1090. β Draconis.

R. A. 17h 27m 43s
Decl. + 52° 23′

1890.334	13°.1	4″.20	. . 14.0	36
.340	10.3	4.14	. . 13.5	36
.356	15.1	4.20	. . 14.0	36
1890.34	12.8	4.18	. . 13.8	
1891.285	12.0	3.99	. . 14.5	36
.326	12.6	4.04	. . 15.0	36
.331	12.2	4.15	. . 14.0	36
1891.31	12.3	4.06	. . 14.5	

1892.263	13.8	4.27	. . 13.5	36
.323	13.0	4.06	. . 13.0	36
.386	14.2	3.79	. . 14.5	36
1892.32	13.7	4.04	. . 13.7	

The measures show that the companion has the same proper motion as the large star, and that it is therefore a physical system.

β 960.

R. A. 17h 32m 2s
Decl. — 1° 5′

1891.545	302.4	3.27	8.5 . . 11.8	12
.564	298.5	2.98	8.5 . . 12.5	12
.567	302.7	2.70	8.0 . . 13.0	12
1891.56	301.2	2.98	8.3 . . 12.4	

Change in angle is probable.

β 962. 26 Draconis.

R. A. 17h 33m 44s
Decl. + 61° 58′

1889.403	127.8	0.90	5.0 . . 11.0	36
.406	131.6	0.99	4.5 . . 11.0	36
.422	131.5	1.01	. . 11.0	36
.438	129.4	0.88	. . 11.0	36
1889.42	130.1	0.95	. . 11.0	
1890.334	130.0	0.83	. .	36
.383	134.5	0.71	. .	36
.406	130.0	0.90	. .	36
1890.37	131.5	0.81	. .	
1891.285	124.6	0.89	5.0 . . 13.0	36
.326	128.9	0.78	. . 11.0	36
.389	123.5	0.67	. . 10.8	36
1891.33	125.7	0.78	. . 11.6	
1892.400	120.4	0.63	. .	36
.422	119.4	0.62	. .	36
1892.41	119.9	0.62	. .	

One of the most remarkable stellar systems. Both components have a large proper motion, as well as rapid orbital motion.

β 961.

R. A. 17h 33m 59s
Decl. + 3° 28′

1892.362	142.3	8.12	7.0 . . 12.0	36
.364	141.3	8.25	7.0 . . 12.0	36
.400	141.3	8.03	6.7 . . 11.5	36
1892.37	141.6	8.13	6.9 . . 11.8	

No change since 1880.

β 631. Ophiuchi 255.

R. A. 17h 33m 47s
Decl. — 0° 35′

1891.567	66.4	0.44	7.5 . . . 7.5	12
.594	68.2	0.36	7.2 . . . 7.5	36
.597	67.1	0.28	7.8 . . . 7.9	36
1891.58	67.2	0.36	7.5 . . . 7.6	

Slow orbital motion.

Δ 16.

R. A. 17h 39m 45s
Decl. + 43° 48′

B and C.

1891.304	145.2	1.48	8.7 . . 9.4	36
.326	145.6	1.34	9.0 . . 10.0	36
.331	145.6	1.26	9.0 . . 10.0	36
1891.32	145.5	1.36	8.9 . . 9.8	

A and B (= Σ 2214).

1891.304	213.4	19.35	8.5 . .	36
.326	212.6	19.43	8.3 . .	36
.331	212.7	19.42	8.7 . .	36
1891.32	212.9	19.40	8.5 . .	

The close pair was discovered by Dembowski, in 1863. There is no material change since that time. The wide pair has remained the same from the first measures by Σ.

A.C. 7. μ Herculis.

R. A. 17h 41m 47s
Decl. + 27° 48′

B and C.

1889.502	359.3	0.58	10.0 . . 10.2	36
.512	358.2	0.54	9.8 . . 10.0	36
.515	355.5	0.57	10.0 . . 10.3	36
.518	357.7	0.51	10.0 . . 10.3	36
1889.51	357.9	0.55	10.0 . . 10.1	

1890.356	9.3	0.63	..	36
.375	11.4	0.76	..	36
.383	9.2	0.61	..	36
.395	7.7	0.65	..	36
1890.38	9.4	0.66	..	
1891.331	18.7	0.71	..	36
.392	18.8	0.80	..	36
.419	18.0	0.65	..	36
1891.38	18.5	0.72	..	
1892.364	28.2	0.93	..	36
.381	30.2	0.87	..	36
.383	27.9	0.87	..	36
1892.37	28.8	0.89	..	

Mr. A. O. LEUSCHNER has computed the orbit of this pair, using the measures down to 1889, and finds a period of 45.24 years. CELORIA (A. N. 2949) makes it 40.65 years.

β 358.

R. A. 17h 43m 10s
Decl. + 34° 32′

1892.395	206°.1	4″.22	8.5 . . 10.5	12

H I. 41.

R. A. 17h 42m 17s
Decl. + 72° 59′

1890.452	341°.3	1″.55	8.5 . . . 8.5	12
.455	341.1	1.24	8.3 . . . 8.3	12
.463	342.1	1.28	8.2 . . . 8.2	36
1890.46	341.5	1.36	8.3 . . . 8.3	

β 633. γ Draconis.

R. A. 17h 53m 49s
Decl. + 51° 30′

1889.227	151°.5	21″.11	. . 12.0	36
.244	151.0	21.17	. . 13.0	36
.288	151.3	21.02	. .	36
1889.25	151.3	21.10	. . 12.5	

The only prior measures are:

1879.09	151°.9	20″.91	β	4 11

β 47.

R. A. 17h 54m 32s
Decl. — 10° 14′

1891.608	274°.1	1″.28	8.0 . . 11.0	12
.613	274.5	1.47	8.0 . . 10.5	36
.625	272.9	1.36	8.0 . . 10.8	12
1891.61	273.8	1.37	8.0 . . 10.8	

Probably some change in angle and distance.

β 283. B.A.C. 6088.

R. A. 17h 54m 38s
Decl. — 22° 47′

1892.362	238°.4	8″.09	6.0 . . 13.0	36
.425	238.9	8.26	6.0 . . 13.0	36
1892.39	238.6	8.17	6.0 . . 13.0	

There is a 14-m. star, 34°.4 : 14″.10 (1892.42).

Trifid Nebula.

R. A. 17h 55m 6s
Decl. — 23° 1′

A and B.

1890.537	23°.0	6″.07	. . 11.0	36
.542	23.1	5.84	8.0 . . 10.8	12
.548	21.5	6.27	. . 10.0	12
1890.54	22.5	6.06	8.0 . . 10.6	

A and C.

1890.537	210°.6	10″.75	7.5 . . .	36
.542	212.6	10.83	. . . 9.0	12
.548	213.7	10.54	8.0 . . . 8.7	12
1890.54	212.3	10.71	7.7 . . . 8.8	

C and D.

1890.537	281°.2	2″.17	8.5 . . 10.5	36
.556	282.3	2.17	9.0 . . 10.5	36
1890.55	281.7	2.17	8.7 . . 10.5	

C and E.

1890.537	191°.1	6″.24	. . 13.5	36
.553	191.8	6.09	. . 11.8	36
.556	189.6	6.25	. . 12.0	36
1890.55	190.8	6.19	. . 12.4	

A and F.

1890.537	106.0	22.22	.. 14.0	36
.553	106.5	21.96	.. 13.5	36
.556	106.7	21.99	.. 14.0	36
1890.55	106.4	22.06	.. 13.8	

C and G.

1890.537	212.2	29.69	.. 13.0	36
.553	211.6	29.54	.. 13.0	36
.556	211.9	29.46	.. 13.5	36
1890.55	211.9	29.56	.. 13.2	

Like the stars in the *Orion* nebula, these stars have remained relatively fixed, and are as uninteresting as the famous trapezium, aside from their accidental surroundings. The large telescope does not show any additional stars in the group near enough to be worth measuring.

β 1125. 68 Ophiuchi.

R. A. $17^h\ 55^m\ 40^s$
Decl. $+\ 1^\circ\ 19'$

1890.447	18.8	0.93	5.0 . . . 8.5	36
.463	20.4	0.94	. . .	36
.496	19.8	0.87	. . . 9.0	36
1890.47	19.7	0.91	. . .	
1892.362	23.4	0.73	5.0 . . . 9.5	36
.364	22.1	0.97	. . . 9.5	36
.383	22.2	0.88	. . . 8.5	36
.400	20.4	0.97	. . .	36
1892.37	22.0	0.89	. . . 9.2	

The angle is increasing.

β 635.

R. A. $17^h\ 56^m\ 40^s$
Decl. $+\ 1^\circ\ 35'$

A and B.

1891.545	116.9	1.57	9.6 . . 11.8	12
.567	115.8	1.22	9.3 . . 11.0	12
1891.55	116.3	1.40	9.4 . . 11.4	

A and C.

1891.545	122.2	69.26	. . . 8.2	12
.567	121.4	69.37	. . . 8.0	12
1891.55	121.8	69.31	. . . 8.1	

β 825.

R. A. $17^h\ 58^m\ 20^s$
Decl. $+\ 25^\circ\ 22'$

A and B.

1889.473	195.1	11.35	.. 11.0	36
.479	194.4	11.00	.. 11.5	36
.482	194.2	11.25	.. 11.5	36
1889.47	194.6	11.20	.. 11.3	
1891.419	194.4	11.47	.. 13.0	36
.452	195.2	11.45	.. 13.0	36
1891.44	194.8	11.46	.. 13.0	

A and C (= Σ 2268).

1889.468	211.4	20.16	8.5 . . . 8.8	12
.473	211.3	20.09	8.5 . . . 8.8	36
.479	212.3	19.75	8.5 . . . 8.8	36
.482	211.3	20.08	8.3 . . . 8.7	36
1889.47	211.6	20.00	8.5 . . . 8.8	
1891.419	211.3	20.28	8.3 . . . 8.5	36
.452	211.5	20.20	8.3 . . . 8.5	36
1891.44	211.4	20.24	8.3 . . . 8.5	

B and C.

1891.419	52.2	9.82	. . .	36
.452	52.2	9.82	. . .	36
1891.44	52.2	9.82	. . .	

The change is probably due to proper motion.

Σ 2272. 70 Ophiuchi.

R. A. $17^h\ 59^m\ 23^s$
Decl. $+\ 2^\circ\ 33'$

A and B.

1889.296	349.0	2.16	. . .	36
.312	348.5	2.16	. . .	36
1889.30	348.7	2.16	. . .	
1892.362	322.2	2.34	. . .	36
.364	321.4	2.15	. . .	36
.383	322.2	2.27	. . .	36
.395	321.9	2.34	. . .	12
1892.37	321.9	2.28	. . .	

A and C.

1889.296	203°.6	59″.40	. . 13.0	36
.312	203.0	59.51	. . 12.5	36
1889.30	203.3	59.45	. . 12.7	

A and D.

1889.296	43°.3	95″.29	. . 12.5	36
.312	43.2	95.06	. . 12.0	36
1889.30	43.2	95.17	. . 12.2	

SECCHI measured these two faint stars in 1856. When observed by HALL, in 1878, it appeared that the nearest of the two had a large proper motion nearly at right angles to that of 70 *Ophiuchi*. Comparing the above measures with HALL'S, it is seen at once that the change in the two faint stars is the same, and corresponds exactly to the recognized proper motion of 70 *Ophiuchi*, and that neither of them has any sensible motion of its own. Laying off the measures to scale, and taking the change in place of the faint star as determined by the two sets of measures, we find the proper motion of the binary system to be, roughly, 1″.2 in the direction of 173°. The measures of SECCHI of the sp star are evidently erroneous, or belong to some other star. The distance of this star in 1856 should have been 97″ in the direction of 191°. His angle of the nf star was exactly right. The distance at that time, by the diagram, should have been about 75″. The distance of the star is, of course, increasing. Roughly speaking, the minimum distance of the sp star from 70 *Ophiuchi* of 30″ will be reached about the year 1932. The measures to this time are as follows:

1856.63	215°.1	87″.57	Se	1 n
1878.84	197.8	71.38	Hl	3 n
1882.79	197.8	65.60	Hl	2 n
1886.52	200.4	62.50	Hl	3 n
1889.30	203.3	59.45	*β*	2 n

For the other star we have:

1856.62	67°.2	. . . .	Se	1 n
1878.84	49.6	87.21	Hl	3 n
1882.79	47.5	92.40	Hl	2 n
1886.52	45.0	93.56	Hl	3 n
1889.30	43.2	95.17	*β*	2 n

I could not see any third component, and both stars appeared to be round with all powers.

OΣ 342. 72 Ophiuchi.

R. A. $18^h\ 1^m\ 42^s$
Decl. $+\ 9°\ 33'$

1889.30 Large star single with 36-inch, and no near companion.

A.C. 15. 99 Herculis.

R. A. $18^h\ 2^m\ 28^s$
Decl. $+\ 30°\ 33'$

1888.733 Apparently single with the 36-inch, as on previous nights with the 12-inch. The last measure of this pair was made by me in 1881.

1889.502	281°.2	0″.65	6.0 . .	11.5	36

I was unable to see the smaller component last year. It is now very difficult, and although seen for an instant on two or three other nights, I could not get a satisfactory measure.

1890.406	285°.2	0″.57	5.5 . .	11.0	36
.463	285.0	0.61	. .		36
.496	285.0	0.51	. .		36
1890.45	285.1	0.56	. .		
1891.540	299.2	0.70	6.0 . .	11.5	36
.559	293.1	0.77	. .	11.5	36
.578	290.9	0.68	. .	12.0	36
1891.56	294.4	0.72	. .	11.7	
1892.400	300.0	0.68	. .		36
.403	298.8	0.69	. .		36
.422	298.9	0.73	. .		36
1892.40	299.2	0.70	. .		

The principal measures are:

1859.63	347°.1	1″.71	Da	2 n
1878.46	24.4	0.99	*β*	3 n
1880.18	29.9	0.91	*β*	3 n
1881.43	29.4	0.51	*β*	1 n

Evidently a binary in rapid motion. For some reason it is extraordinarily difficult for the assigned magnitudes and distance. GORE has recently computed an orbit for this interesting binary, using these measures, and finds a period of 53.55 years.

β 637.

R. A. 18h 3m 53s
Decl. + 3° 7′

1891.633	194.°7	7.″30	6.3 . . 11.8	36
.655	195.2	7.36	6.5 . . 12.4	36
1891.64	194.9	7.33	6.4 . . 12.1	

No motion since 1878.

β 759.

R. A. 18h 3m 49s
Decl. — 39° 22′

A and B.

1889.389	121.°7	1.″80	9.0 . . . 9.3	12
.392	120.7	1.94	9.0 . . . 9.3	12
.430	121.7	1.68	8.6 . . . 8.7	12
1889.40	121.4	1.81	8.9 . . . 9.1	

A and C (= *H* 5028).

1889.389	146.°4	14.″99	. . . 9.2	12
.392	147.9	15.05	. . . 9.2	12
.430	147.6	14.71	. . . 8.5	12
1889.40	147.3	14.92	. . . 9.0	

β 132.

R. A. 18h 4m 7s
Decl. — 19° 52′

1891.490	231.°0	0.″90	7.5 . . . 7.7	12
.526	229.3	0.77	7.0 . . . 7.0	12
.531	231.2	0.85	7.3 . . . 7.3	12
1891.51	230.5	0.83	7.3 . . . 7.3	

Probably retrograde motion.

β 286. 16 Sagittarii.

R. A. 18h 8m 9s
Decl. — 20° 25′

1891.633	215.°9	5.″93	6.0 . . 12.0	36
.636	216.1	6.13	6.0 . . 12.0	36
1891.63	216.0	6.03	6.0 . . 12.0	

β 284.

R. A. 18h 9m 13s
Decl. — 19° 2′

A and B.

1891.633	360.°3	17.″93	6.9 . . 11.0	36
.636	359.4	18.00	7.5 . . 10.8	36
1891.63	359.8	17.96	7.2 . . 10.9	

A and C.

1891.633	86.°6	31.″39	. . 10.8	36
.636	87.4	31.19	. . 10.8	36
1891.63	87.0	31.29	. . 10.8	

A and *a*.

1891.633	199.°1	12.″15	. . 11.0	36
.636	200.4	11.76	. . 11.0	36
1891.63	199.7	11.95	. . 11.0	

A and *b*.

1891.633	66.°3	22.″05	. . 10.8	36
.636	67.0	22.14	. . 10.9	36
1891.63	66.6	22.09	. . 10.8	

B and *c*.

1891.633	328.°8	5.″14	. . 12.3	36
.636	329.1	4.95	. . 11.4	36
1891.63	328.9	5.04	. . 11.9	

β 760. η Sagittarii.

R. A. 18h 9m 31s
Decl. — 36° 48′

A and B.

1889.389	106.°1	3.″89	4.0 . . 11.5	12
.392	110.8	3.32	4.0 . . 11.5	12
.430	104.5	3.42	4.0 . . 11.0	12
.438	106.8	3.40	5.0 . . 11.5	12
1889.41	107.0	3.51	. . 11.4	

A and C.

1889.389	302.°5	93.″25	. . 10.0	12
.438	303.1	93.20	. . 10.0	12
1889.41	302.8	93.22	. . 10.0	

β 246.

R. A. 18h 10m 30s
Decl. — 19° 43′

1892.633	106.°7	0.″52	8.3 . . . 8.3	36
.636	104.6	0.51	8.1 . . . 8.1	36
1891.63	105.6	0.51	8.2 . . . 8.2	

Change uncertain.

β 299.

R. A. 18h 10m 48s
Decl. — 18° 51′

A and B.

1891.636	12°.3	53″.57	6.8 . . . 7.5	36
.652	12.6	53.81	7.0 . . . 8.0	36
1891.64	12.4	53.69	6.9 . . . 7.7	

B and *c*.

1891.636	133°.1	10″.59	. . 13.5	36
.652	130.7	10.30	. . 13.5	36
1891.64	131.9	10.44	. . 13.5	

A and *f*.

1891.652	65°.5	29″.31	. . 13.5	36
.655	66.5	29.54	. . 13.5	36
1891.65	66.0	29.42	. . 13.5	

A and *e*.

1891.652	22°.1	22″.20	. .	36

e and *d*.

1891.652	304°.4	7″.20	12.5 . . 12.5	36
.655	306.3	7.03	13.3 . . 13.3	36
1891.65	305.3	7.11	12.9 . . 12.9	

A and *h*.

1891.652	327°.9	22″.04	. .	36

g and *h*.

1891.652	317°.4	8″.39	13.0 . . 13.5	36

The bright stars AB make the double, Sh. 263. No other measures of the small stars.

β 300, 639.

R. A. 18h 11m 40s
Decl. — 18° 40′

AB and C.

1891.652	52°.9	17″.18	7.5 . . . 8.0	36
.655	52.0	17.24	6.7 . . . 7.5	36
1891.65	52.4	17.21	7.1 . . . 7.7	

C and D.

1891.652	328°.0	8″.20	. . 13.5	36
.655	323.0	8.39	. . 13.5	36
1891.65	325.5	8.30	. . 13.5	

The close pair, which was discovered with the 18½-inch, in 1878, is now (1892.36) closed up, or so nearly so, that it is apparently single.

β 640.

R. A. 18h 16m 3s
Decl. + 27° 28′

1892.383	341°.1	2″.20	8.0 . . 11.5	36

β 641.

R. A. 18h 16m 43s
Decl. + 21° 27′

1890.447	346°.4	1″.03	7.0 . . . 9.0	36
.455	341.2	1.15	7.5 . . . 9.0	12
.458	350.2	0.85	7.5 . . . 9.0	36
1890.45	345.9	1.01	7.3 . . . 9.0	

There seems to be slow motion in the angle.

1878.68	356°.4	1″.07	Δ	1 n
1880.12	349.2	1.00	β	5 n

β 1203.

R. A. 18h 19m 56s
Decl. + 0° 44′

1892.400	66°.8	0″.32	7.0 . . . 7.2	36

No change since 1890.

β 464.

R. A. 18h 21m 45s
Decl. + 6° 29′

1891.608	108°.1	0″.95	8.7 . . 9.5	12
.613	109.3	1.06	8.5 . . 10.3	36
.622	107.2	1.08	8.5 . . 9.2	12
1891.61	108.2	1.03	8.6 . . 9.7	

Probably unchanged.

Σ 2315.

R. A. 18h 20m 12s
Decl. + 27° 20′

1892.381	218°.0	0″.24	7.8 . . . 8.5	36
.383	220.8	0.30	8.0 . . . 8.7	36
.400	222.8	0.30	7.8 . . . 8.5	36
1892.39	220.5	0.28	7.9 . . . 8.6	

β 642.

R. A. 18h 26m 50s
Decl. — 10° 29′

1891.608	88°.9	4″.18	9.0 . . 11.0	12
.622	93.0	4.18	9.0 . . 11.0	12
.625	92.4	4.07	8.8 . . 10.8	12
1891.62	91.4	4.14	8.9 . . 10.9	

The principal star of a cluster. Without change.

β 643.

R. A. 18h 29m 41s
Decl. + 4° 50′

A and B.

1891.671	334°.9	9″.32	6.0 . . 12.5	36
.673	337.2	9.26	6.0 . . 12.5	36
.689	336.7	9.23	6.0 . . 13.0	36
1891.67	336.3	9.27	6.0 . . 12.7	

A and C (= Σ 2342).

1891.671	7°.4	29″.18	. . . 9.0	36
.673	7.6	29.00	. . . 9.0	36
.689	7.0	29.18	. . . 8.5	36
1891.67	7.3	29.12	. . . 8.7	

The change in these stars is due to proper motion.

0Σ 357.

R. A. 18h 30m 21s
Decl. + 11° 37′

1888.627	252°.5	0″.40	8.0 . . . 8.0	12
1889.502	253.9	0.40	8.5 . . . 8.5	36
.512	251.9	0.46	8.0 . . . 8.2	36
1889.21	252.8	0.42	8.2 . . . 8.2	

Probably a binary, but the motion is very slow.

β 50.

R. A. 18h 33m 58s
Decl. + 39° 29′

A and B.

1892.383	6°.9	21″.96	8.5 . . 13.0	36

C and D.

1892.383	167°.2	5″.85	9.5 . . 11.0	36

A and C.

1892.383	330°.0	73″.06	. . .	36

Σ 2367.

R. A. 18h 36m 39s
Decl. + 30° 11′

1891.326	107°.1	0″.07±	. . .	36
.389	109.3	0.09	7.5 . . . 7.7	36
.578	104.6	0.09	7.0 . . . 7.5	36
1891.43	107.0	0.09	7.2 . . . 7.6	
1892.400	95.7	0.14	. . .	36
.403	98.1	0.12	. . .	36
.422	99.0	0.14	. . .	36
1892.40	97.6	0.13	. . .	

For a list of all the measures of this pair see A. N. 3074.

Σ 2384.

R. A. 18h 38m 33s
Decl. + 67° 0′

1890.534	306°.3	0″.42	8.0 . . . 8.1	36
.573	305.6	0.41	. . .	36
.575	308.4	0.39	8.0 . . . 8.2	36
1890.56	306.8	0.41	. . .	

Probably a binary, but there has been little change in the angle.

ζ Lyrae.

R. A. 18h 40m 38s
Decl. + 37° 29′

A and B.

1889.425	48°.6	26″.79	. . 15.5	36
.433	48.8	27.08	. . 16.0	36
1889.43	48.7	26.93	. . 15.7	

A and C (= Σ 38 App. I).

1889.425	149°.5	43″.77	. . .	36
.433	149.2	43.70	. . .	36
1889.43	149.3	43.73	. . .	

The very faint star B has not been seen before. It is much more difficult than the companion found with the 18½-inch, 43″.37 from the principal star, in the direction of 274°.4.

β 465.

R. A. 18h 41m 38s
Decl. + 56° 45′

	°	″			
1891.531	295.4	2.99	8.7	11.0	12
.610	292.2	3.04	8.3	9.5	36
.622	298.6	3.34	8.3	11.0	12
1891.59	295.4	3.12	8.4	10.5	

β 969.

R. A. 18h 43m 49s
Decl. — 8° 3′

	°	″			
1892.381	238.0	14.11	7.0	11.8	36

This is the red star *Birmingham* 464.

Σ 2400.

R. A. 18h 43m 32s
Decl. + 16° 7′

A and B.

	°	″			
1889.460	190.8	1.65	8.0	11.2	36
.471	188.7	1.64	8.0	11.1	36
.473	187.4	1.60	8.5	11.0	36
.482	189.2	1.55	8.5	11.1	36
1889.47	189.0	1.61	8.2	11.1	
1892.422	190.0	1.79	8.0		36
.425	184.4	1.95	8.2		36
1892.42	187.2	1.87	8.1		

A and C (= Σ 2400).

	°	″			
1889.460	193.0	2.38		11.0	36
.471	190.4	2.67		11.0	36
.473	192.3	2.54		11.0	36
.482	191.0	2.56		11.0	36
1889.47	191.7	2.54		11.0	
1892.425	201.9	2.78			36

B and C.

	°	″			
1889.473	17.5	0.84			36
.482	17.6	0.78			36
1889.48	17.5	0.81			
1892.422	201.4	0.65	10.5	10.5	36
.425	198.2	0.65	10.8	10.8	36
1892.42	199.8	0.65	10.6	10.6	

The small star B was discovered by PERROTIN, and independently by YOUNG, with the Princeton 23-inch. The change in the position of the STRUVE companion is due to the proper motion of A. B and C appear to be relatively fixed. As they are of substantially the same magnitude, it is singular that STRUVE and later observers should have failed to see the other companion. As a matter of fact, the latter was measured by *OΣ*, in 1872, for the old companion.

β 970.

R. A. 18h 44m 15s
Decl. — 8° 8′

	°	″			
1892.381	107.9	1.54	8.3	10.7	36

β 971. Draconis 205.

R. A. 18h 44m 24s
Decl. + 49° 18′

	°	″			
1891.389	6.7	0.36	6.5	9.0	36
.473	3.2	0.36	7.5	10.0	36
.575	3.5	0.37	6.5	8.5	36
1891.48	4.5	0.36	6.8	9.2	

The angle is increasing, and the distance diminishing.

OΣ 364.

R. A. 18h 48m 24s
Decl. + 25° 14′

1892.364 No double found here with the 36-inch. Splendid seeing.

This star was measured once as a close pair, in 1842, by *OΣ*. The companion was called 11-m. at a distance of o″.7 from the principal star. He states that he was never afterwards able to see it. MADLER found it single in 1851, and DEMBOWSKI in 1865. I could not see any signs of duplicity with the Chicago 18½-inch, in 1878, and as the large refractor here also fails, it is safe to say that this star is not really double, and further examination is unnecessary.

β 137.

R. A. 18h 49m 48s
Decl. + 37° 14′

	°	″			
1891.482	128.7	1.21	8.3	8.5	12
.487	129.7	0.98	8.5	8.7	12
.518	131.5	1.22	8.0	8.2	36
1891.49	130.0	1.14	8.3	8.5	

The angle may be slowly increasing.

Σ 3130 = 0Σ 365.

R. A. $18^h\ 52^m\ 20^s$
Decl. $+\ 44^\circ\ 4'$

1889.460 The principal star is certainly
.463 single, with powers up to
1900 on the 36-inch.
1890.575 Certainly not double. First
rate night.

This is the principal star of Σ 3130. I have examined this star many times with different instruments, and never saw the least suspicion of duplicity. On the whole, the weight of the evidence is against its really being double.

β 648. B.A.C. 6480.

R. A. $18^h\ 52^m\ 30^s$
Decl. $+\ 32^\circ\ 45'$

1891.285	249.3	1.28	6.0 . . 10.5	36
.326	247.3	1.30	6.0 . . 10.0	36
.389	246.5	1.19	6.0 . . 10.5	36
1891.33	247.7	1.26	6.0 . . 10.3	
1892.364	244.6	1.20	6.0 . . 10.0	36
.381	248.7	1.38	6.0 . . 9.5	36
.383	244.3	1.16	6.0 . . 8.7	36
.386	246.3	1.49	6.0 . . 8.7	36
.403	244.3	1.22	6.0 . . 9.0	36
1892.38	245.6	1.29	6.0 . . 9.2	

A binary in rapid motion. It is a naked-eye star near *γ Lyrae*.

β 649.

R. A. $18^h\ 54^m\ 24^s$
Decl. $+\ 32^\circ\ 19'$

1891.326	7.8	1.56	8.2 . . 10.0	36
.389	9.6	1.56	8.3 . . 11.0	36
.392	4.5	1.65	8.2 . . 10.8	36
1891.37	7.3	1.59	8.2 . . 10.6	

This is near the last preceding pair.

ζ Sagittarii.

R. A. $18^h\ 55^m\ 0^s$
Decl. $-\ 30^\circ\ 3'$

1888.592	260.1	0.55	. . .	12
.600	255.9	0.66	. . .	12
.605	258.4	0.86	. . .	12
.613	255.4	0.73	. . .	12
.636	256.8	0.64	. . .	12
.681	257.9	0.75	. . .	12
1888.62	257.4	0.70	. . .	
1889.389	252.4	1.06	. . .	12
.392	254.2	0.70	3.5 . . . 3.6	12
.397	258.9	0.79	. . .	36
.430	253.6	0.66	. . .	12
.438	256.6	0.82	4.0 . . . 4.2	12
1889.41	255.1	0.81	. . .	
1890.452	250.4	0.65	. . .	12
.499	253.6	0.90	. . .	36
.523	249.3	0.74	. . .	12
1890.49	251.1	0.76	. . .	
1891.526	246.6	0.62	4.0 . . . 5.0	12
.531	246.1	0.59	4.0 . . . 5.0	12
.534	246.7	0.61	. . .	12
1891.53	246.5	0.61	. . .	
1892.364	243.8	0.53	. . .	36
.403	246.9	0.71	. . .	36
.422	244.6	0.57	. . .	36
1892.39	245.1	0.60	. . .	

An interesting pair discovered by WINLOCK, of which there are but few measures until recently. It was first measured by NEWCOMB. Possibly some of the observations require a correction of 180° in the angle, but this matter was given careful attention in the measures of 1878–80, and there seemed to be no doubt of the smaller component being on the following side. It is certainly on the preceding side now. The difference is about one half a magnitude. GORE finds a period of 18.69 years.

The following are the earlier measures:

1867.80	260.8	0.48	N	1 n
1878.70	84.2	0.42	β	1 n
1879.71	54.8	0.3±	β	1 n
1880.62	62.1	0.55	β	2 n
1881.61	36.1	0.31	β	2 n

Σ 2438.

R. A. $18^h\ 55^m\ 29^s$
Decl. $+\ 58^\circ\ 4'$

1889.460	46.0	0.22	7.0 . . . 7.0	36
.463	43.7	0.23	7.0 . . . 7.1	36
.470	48.9	0.26	7.5 . . . 7.7	36
1889.46	46.2	0.24	7.2 . . . 7.3	

1890.499	47.°0	0.″25	6.5 . . . 6.7	36
.537	41.3	0.23	. . .	36
.573	45.6	0.27	. . .	36
1890.54	44.6	0.25	. . .	
1892.400	42.3	0.27	7.3 . . . 7.5	36
.422	42.6	0.25	7.5 . . . 7.7	36
.425	41.3	0.22	7.8 . . . 8.8	36
1892.41	42.1	0.25	7.5 . . . 8.0	

This star has been apparently single with ordinary instruments for many years. In the above measures, particular attention was given to the proper quadrant. It is now opening out, but the motion is slow. The measures here, taken in connection with those of Σ and $O\Sigma$, indicate a period of about 120 years. HERSCHEL'S angle, in 1783 seems to be some 20° too small to fall in with the later observations.

β 973.

R. A. 18h 55m 59s
Decl. + 8° 34′

A and B.

1890.594	350.°1	1.″49	9.0 . . 11.5	36
.610	350.0	1.72	9.0 . . 12.0	36
.630	350.0	1.59	9.0 . . 10.8	36
1890.61	350.0	1.60	9.0 . . 11.6	

C and D (HOWE).

1890.594	259.°3	3.″27	11.0 . . 11.1	36
.610	261.3	3.23	11.0 . . 11.3	36
.630	259.8	3.23	11.0 . . 11.2	36
1890.61	260.1	3.24	11.0 . . 11.2	

A and C.

1890.594	18.°6	11.″03	. .	36
.610	21.2	11.02	. .	36
.630	19.5	11.12	. .	36
1890.61	19.8	11.06	. .	

A and D (Σ 2435).

1890.594	12.°6	10.″04	. .	36
.610	11.8	10.16	. .	36
1890.60	12.2	10.10	. .	

There has been no change in the STRUVE star, and probably none in the close pairs.

1880.13	350.°7	1.′43	β	5 n
1880.13	262.7	2.90	β	5 n

H. N. 126.

R. A. 18h 57m 10s
Decl. — 21° 43′

1890.452	353.°8	0.″55	8.0 . . . 8.2	12
.496	355.1	0.62	. . .	36
.499	350.6	0.58	8.0 . . . 8.0	36
1890.48	353.2	0.58	8.1 . . . 8.1	
1891.389	348.8	0.41	7.5 . . . 7.5	36
.559	349.4	0.51	7.8 . . . 8.0	36
.575	349.6	0.51	7.5 . . . 7.5	36
1891.51	349.3	0.48	7.6 . . . 7.7	

This pair seems to be moving rapidly. In 1873, finding it had never been observed apparently since the time of HERSCHEL, and as his description of it was limited to giving it as belonging to his Class I, I looked it up, and fortunately estimated the angle and distance. Subsequently it was measured at Cincinnati, and these are all the observations down to this time. The distance is certainly diminishing, and probably the motion in angle is rapid.

1873.00	40.°0±	0.″1 ±	β	
1879.53	22.4	0.83	Cin	2 n

γ Coronae Australis.

R. A. 18h 58m 18s
Decl. — 37° 14′

1889.389	185.°3	2.″05	5.5 . . . 5.5	12
.392	187.0	1.54	. . .	12
.430	183.6	1.84	. . .	12
.438	185.7	1.73	5.5 . . . 5.5	12
1889.41	185.4	1.79	5.5 . . . 5.5	
1891.526	178.3	1.71	5.5 . . . 5.5	12
.531	175.9	1.86	. . .	12
.534	176.4	1.47	. . .	12
1891.53	176.9	1.68	. . .	

GORE (*Monthly Notices*, May, 1892) finds a period of 154.41 years, and SELLORS (*Monthly Notices*, November, 1892) a period of 121.24 years.

β 974.

R. A. 18h 58m 53s
Decl. — 6° 21′

1891.389	83°.3	0″.97	9.0 . . . 9.2	36
.419	85.5	0.95	9.0 . . . 9.2	36
1891.40	84.4	0.96	9.0 . . . 9.2	

β 466.

R. A. 18h 59m 34s
Decl. + 10° 39′

1891.763	167°.0	1″.75	8.5 . . . 9.0	12
.775	164.8	1.94	8.5 . . . 9.0	12
1891.77	165.9	1.84	8.5 . . . 9.0	

No change since 1877.

β 287. ζ Aquilae.

R. A. 18h 59m 54s
Decl. + 13° 41′

1889.422	56°.5	5″.70	. .	36
.433	58.5	5.56	. . 13.0	36
.436	56.8	5.64	. . 13.0	36
1889.43	57.3	5.63	. . 13.0	

Very little change in this pair since 1874.

β 359.

R. A. 19h 0m 7s
Decl. + 23° 13′

1891.763	83°.0	4″.19	8.5 . . . 9.5	12
.775	89.9	3.49	8.4 . . . 9.2	12
1891.77	86.4	3.84	8.4 . . . 9.3	

Δ made the distance 4″.29 in 1876.

Σ 2447.

R. A. 19h 0m 22s
Decl. — 1° 32′

1891.389 The large star is round, with powers up to 1000. There is a 14-m companion, a little nearer than the Σ star, in the direction of 180°.

Some fifteen years ago I suspected an elongation of the principal star of this pair, but was never able to verify it, or satisfy myself that it was not double.

Δ 19. Cygni 4.

R. A. 19h 5m 52s
Decl. + 55° 8′

A and B.

1892.400	18°.0	0″.75	7.8 . . . 9.2	36
.422	22.2	0.68	8.0 . . . 9.5	36
.425	20.3	0.70	8.0 . . . 9.5	36
1892.41	20.2	0.71	7.9 . . . 9.4	

A and C (= Σ 2479).

1892.400	32°.9	7″.03	. . . 8.8	36
.422	32.6	7.10	. . . 9.0	36
.425	33.3	6.98	. . . 9.0	36
1892.41	32.9	7.04	. . . 8.9	

β 422.

R. A. 19h 7m 34s
Decl. — 18° 16′

1891.534	45°.5	12″.18	8.2 . . 13.0	12
.537	42.9	12.46	8.3 . . 11.0	12
.633	43.3	12.55	8.0 . . 11.5	36
1891.57	44.6	12.40	8.2 . . 11.8	

No other measures of distance.

β 975.

R. A. 19h 10m 4s
Decl. + 34° 21′

B and C.

1890.613	222°.0	0″.84	9.0 . . 9.7	36
.633	219.8	0.74	10.0 . . 11.3	36
.649	225.0	0.91	9.0 . . 9.5	36
1890.63	222.3	0.83	9.3 . . 10.2	

A and B (= OΣ 367).

1890.633	227°.3	33″.34	7.5 . .	36

No change in the wide pair, and probably none in the other.

1880.59	221°.8	0″.77	β	3 n

β 140.

R. A. 19h 10m 12s
Decl. — 11° 11′

A and B.

1891.534	327°.3	37″.09	7.0 . .	12
.537	326.1	36.84	8.0 . .	36
.581	327.3	36.67	7.7 . .	36
1891.55	326.9	36.87	7.6 . .	

B and C.

1891.537	208°.1	7″.13	11.0 . . 11.2	36
.581	210.5	7.24	11.0 . . 11.2	36
1891.56	209.3	7.18	11.0 . . 11.2	

β 248. 2 Vulpeculae.

R. A. 19h 12m 39s
Decl. + 22° 49′

1890.613	126°.9	1″.71	. . .	36
.630	124.6	1.97	. . .	36
.649	124.8	1.89	. . .	36
1890.63	125.4	1.86	. . .	

Some of the measures of this pair are not very accordant, but on the whole there is little evidence of change.

1876.11	125°.0	1″.86	Δ	6 n

β 360.

R. A. 19h 14m 18s
Decl. + 35° 0′

A and B.

1891.763	72°.8	6″.65	8.5 . . 10.0	12
.775	70.9	6.32	8.4 . . 9.5	12
1891.77	71.8	6.48	8.4 . . 9.7	

A and C.

1891.763	343°.2	36″.55	. . 11.0	12
.775	341.0	36.35	. . 12.0	12
1891.77	342.1	36.45	. . 11.5	

No material change.

H. A. Howe.

R. A. 19h 14m 37s
Decl. + 2° 43′

1890.556	333°.2	0″.35	8.5 . . . 8.5	36
.564	335.8	0.40	8.0 . . . 8.2	36
.573	333.0	0.43	8.0 . . . 8.2	36
1890.56	334.0	0.39	8.2 . . . 8.3	

No evidence of change since its discovery by Howe at Cincinnati.

1879.52	336°.0	0″.4±	Cin	3 n

Σ 2505.

R. A. 19h 15m 32s
Decl. + 35° 19′

1891.326 Both stars perfectly round with the 36-inch. Fine seeing.

Tarrant, in 1886, thought the larger component might be a close pair.

β 141.

R. A. 19h 16m 50s
Decl. + 22° 17′

1890.613	81°.5	0″.81	. . .	36
.649	79.0	0.84	. . .	36
.652	77.0	0.75	7.5 . . . 8.5	36
1890.64	79.2	0.80	. . .	

This is the principal star of the wide pair, *H* 2867. The larger telescope also shows that *H's* companion, 26″ from the larger star, is a 4″ or 5″ pair. Thus far there is no evidence of change in the pair measured above.

Σ 2525.

R. A. 19h 21m 40s
Decl. + 27° 5′

1891.326	343°.7	0″.20	8.0 . . . 8.1	
.389	343.4	0.17	8.0 . . . 8.2	
.427	163.7	0.17	8.0 . . . 8.5	
.447	342.7	0.17	8.0 . . . 8.1	
1891.40	343.4	0.18	. . .	
1892.422	328.3	0.27	8.0 . . . 8.0	36

[From *Monthly Notices, R. A. S.*, December, 1891.]

For some years this has been a difficult pair to measure. When it was discovered and first measured by Struve in 1830, it could be readily seen with the smallest instrument ordinarily used in double-star work. Since that time the distance has gradually lessened, and for the past few years only the largest refractors can separate the components. Until recently the change has been principally in distance, and all the measures made during the first fifty years are well represented by rectilinear motion. Notwith-

standing that these positions appear to represent the movement of one star passing another from proper motion, the chances are greatly in favor of a physical relation between them.

I have made a set of measures of this pair with the 36-inch equatorial under very favorable atmospheric conditions. Although the distance between the components is less than 0″.2, it is easy enough with this instrument, since it is well separated with medium powers, and the measures should have a good degree of accuracy.

In very close pairs of this kind, and particularly when the relative motion is not well understood, it is important to assign the proper quadrant to the smaller star. In the first three measures the angles were set down as above with no thought of the earlier observations, with a note, "quadrant certain," in the second measure. On the following night the angle was reversed, and on the last night the smaller component seemed to be on the preceding side, although the difference in the magnitudes was very small. The magnitudes in STRUVE are 7.4 and 7.6.

In order to determine this question more certainly, if possible, I examined the pair again on several nights, with the following results:

1891.485 Not very good seeing, but the star appears to be in 160°.

1891.540 The stars are so nearly equal that it is impossible to tell with certainty which is the smaller. Well separated.

1891.578 The preceding star appears to be certainly the smallest, but the difference is perhaps not more than 0.1 or 0.2 of a magnitude. Splendid seeing.

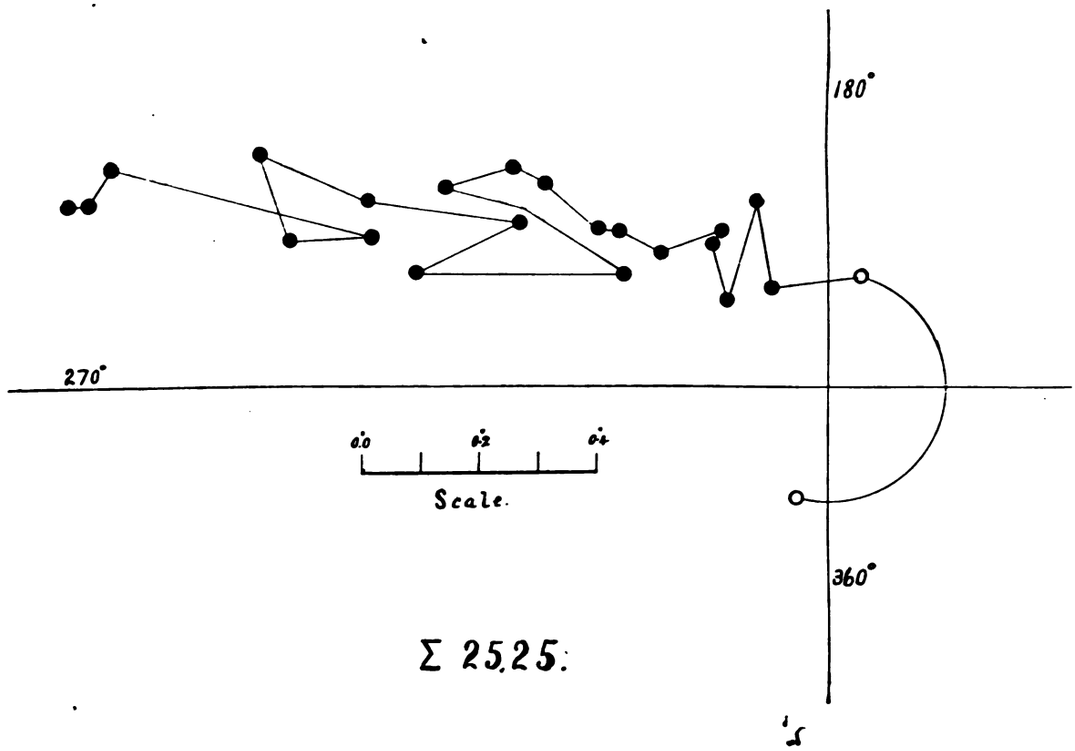
The quadrant, therefore, is still uncertain, but the weight of the evidence, from my own observations, seems to be in favor of the position-angle being as given in the mean result of the several measures, and not 163°.4; but the latter seems to be more in harmony with the earlier observations. This can probably be definitely settled by the observations of next year. If the angle is what I have assumed it to be, then the angular movement has been 270° since 1830, and we should have sufficient data for an approximate determination of the period. On the other hand, if this position belongs in the opposite quadrant, then all the measured positions lie substantially in a straight line, and it would be impossible to say from this evidence alone whether the relative change is due to proper or orbital motion.

In the interest of a future investigation, I have collected from original sources, and arranged in chronological order, all the micrometrical observations of this pair, and give them here:

MEASURES OF Σ 2525.

		°	″		
1	1830.43	255.9	1.33	Σ	5 n
2	1836.14	255.5	1.30	Σ	2 n
3	1840.62	255.5	...	Da	1 n
	1840.70	252.4	1.28	*O*Σ	2 n
4	1842.41	251.0	0.82	Ma	1 n
5	1843.69	254.0	0.95	Ma	1 n
6	1854.63	246.8	1.05	*O*Σ	1 n
7	1856.61	247.1	0.85	Se	2 n
8	1865.22	240.9	0.60	△	7 n
9	1865.48	73.6	0.73	En	2 n
10	1865.64	239.9	0.40	Se	1 n
11	1865.76	241.5	0.74	*O*Σ	2 n
12	1872.61	234.0	0.66	*O*Σ	1 n
	1873.54	241.1	...	Ferr	1 n
13	1873.61	233.4	0.60	△	4 n
	1873.65	232.1	...	WS	3 n
14	1874.84	234.3	0.48	Gl	1 n
15	1875.66	233.6	...	WS	1 n
	1875.65	232.1	0.45	Sp	5 n
16	1877.01	230.1	0.37	Sp	5 n
	1877.82	238.0	...	△	1 n
17	1879.71	213.2	0.33	Hl	3 n
	1879.79	243.0	...	Do	3 n
18	1880.67	217.8	0.32	Sp	6 n
	1880.71	210.0	...	Do	2 n
19	1883.26	47.9	0.23	En	8 n
20	1883.63	200.0	0.35	Sp	4 n
	1883.58	Elong. 27°		Per	4 n
21	1886.92	208.6	0.2±	Sp	2 n
	1887.71	Single		Sp	4 n
22	1891.40	343.4	0.18	β	4 n

All of the measures in the foregoing list which are complete, twenty-two in number, are laid off to scale on the accompanying diagram as accurately as possible, and show at a glance all of the observed positions of this pair. The measures of 1891 are shown by outline circles in both quadrants. The successive measures are connected by lines, so that any one of them can be readily identified in the tabular list.



The resemblance between this pair and 20 *Draconis* is very striking, not only in the general direction of the components with reference to each other and their relative motions, but in the direction of the apparent movement of the respective companions. This will be very apparent by comparing the present diagram with that of 20 *Draconis* given in my paper on that pair in *Monthly Notices* for June, 1891. The apparent relative motion of Σ 2525 is in the direction of about 83°, while that of 20 *Draconis*, as I have previously shown, is in the direction of 73°. Assuming that these are binary pairs—as is most probably the case—it is obvious that the apparent ellipses must be extremely elongated, and that the periods are of long duration. In a few years more, doubtless, we shall have data for a better determination of these points.

[Since the foregoing was written, GORE has computed the orbit of this pair, using the observations collected above, and my later measures of 1892, and finds a period of 138.54 years. (*Monthly Notices*, *R. A. S.*, November, 1892.) This is based upon the assumption that the smaller component is now in the fourth quadrant.]

β 424.

R. A. 19h 23m 5s
Decl. + 35° 49′

	°	″		
1891.763	41.1	2.36	8.7 . . . 9.2	12
.775	39.2	2.84	8.7 . . . 9.5	12
1891.77	40.1	2.60	8.7 . . . 9.3	

Δ 21.

R. A. 19h 25m 1s
Decl. — 2° 22′

A and B.

	°	″		
1890.675	67.7	1.03	7.5 . . . 9.0	36
.706	67.0	1.05	7.0 . . . 9.0	36
.709	65.9	1.03	7.5 . . . 9.0	36
1890.70	66.9	1.04	7.3 . . . 9.0	

A and C (Σ 2535).

1890.675	298°.0	26″.15	...9.0	36
.706	297.9	26.17	...9.0	36
.709	298.1	26.30	...9.5	36
1890.70	298.0	26.21	...9.2	

The close pair is the principal star of Σ 2535, discovered by DEMBOWSKI in 1865. There is very little evidence of change thus far.

1865.76	70°.0	1″.22	Δ	2 n

I observed this star principally for the purpose of finding whether the third star near A, suspected by Δ, had any real existence. I have never been able to see it with other large telescopes, and as the 36-inch fails to show it, it will not be necessary to make any further search.

β 651.

R. A. 19h 25m 44s
Decl. + 28° 2′

1892.383	287°.7	6″.40	8.3..11.0	36
.386	289.5	6.48	8.5..11.8	36
1892.38	288.6	6.44	8.4..11.4	

β 650.

R. A. 19h 26m 20s
Decl. + 6° 15′

A and B.

1891.485	144°.2	6″.71	8.2..11.5	36
.499	143.2	6.51	8.0..11.8	36
1891.49	143.7	6.61	8.1..11.6	

A and C.

1891.485	332°.1	11″.57	..13.0	36
.499	332.5	11.66	..13.0	36
1891.49	332.3	11.61	..13.0	

A and D.

1891.485	255°.1	26″.95	..10.0	36
.499	254.0	26.31	..10.0	36
1891.49	254.5	26.63	..10.0	

The principal star is *L* 36958, and not *L* 36918, as given at first.

β 976. Aquilae 122.

R. A. 19h 26m 27s
Decl. + 9° 5′

1891.389	105°.1	2″.06	7.0..11.0	36
.416	105.3	2.16	7.0..11.0	36
.449	102.4	2.25	7.5..10.0	36
1891.42	104.3	2.16	7.2..10.7	

β 438.

R. A. 19h 27m 3s
Decl. + 36° 27′

A and B.

1891.502	41°.0	4″.12	7.5..13.0	36
.537	40.0	3.98	8.0..12.5	36
1891.53	40.5	4.05	7.7..12.7	

C and D (= Σ 2538).

1891.502	52.7	6.02	7.0...7.8	36
.526	54.8	6.10	8.2...8.2	12
1891.51	53.8	6.06	7.6...8.0	

A and C.

1891.502	247°.7	46″.99	...	36
.526	248.2	46.89	8.2...8.2	12
1891.51	247.9	46.94	8.2...8.2	

A and E.

1891.502	236°.3	21″.69	..13.0	36
.537	237.1	21.36	..12.6	36
1891.52	236.7	21.52	..12.8	

A and D.

1891.526	246°.3	52″.97	..	12
.534	245.8	53.12	..	12
1891.53	246.0	53.04	..	

β 652.

R. A. 19h 27m 16s
Decl. + 28° 1′

A and B.

1892.381	323°.7	5″.08	..13.5	36
.383	326.3	5.15	..13.0	36
.386	325.9	5.28	..13.5	36
1892.38	325.3	5.17	..13.3	

A and C (= Σ 2539).

1892.381	4.2	5.43	8.3 . . . 9.0	36
.383	2.6	5.45	7.8 . . . 8.5	36
.386	3.6	5.32	8.0 . . . 8.6	36
1892.38	3.5	5.40	8.0 . . . 8.7	

No change in the Σ companion. The distance of the other may be increasing.

β 653. μ Aquilae.

R. A. 19h 28m 13s
Decl. + 7° 8′

A and B.

1891.419	276.8	24.74	. .	36
.449	276.4	25.23	. .	36
1891.43	276.6	24.98	. .	

A and C.

1891.419	288.6	25.12	. .	36
.449	288.3	25.13	. .	36
1891.43	288.4	25.12	. .	

B and C.

1891.419	195.5	4.86	11.5 . . 11.5	36
.449	195.9	5.27	13.0 . . 13.2	36
1891.43	195.7	5.06	12.2 . . 12.3	

The change in the distance of these two faint companions since my measures in 1878 appears to correspond to the proper motion of the principal star, which is given as 0″.232 in the direction of 124°.1.

β 654. 52 Sagittarii.

R. A. 19h 29m 24s
Decl. — 25° 10′

1889.392	159.3	2.98	5.0 . . 11.0	12
.430	159.1	2.97	4.5 . . 11.5	12
.433	159.2	3.01	5.0 . . 12.0	36
.438	158.7	3.06	6.0 . . 11.5	12
1889.42	159.1	3.00	5.1 . . 11.5	

The following are all the measures:

1878.57	160.8	2.93	β	3 n
1878.72	163.2	2.64	Cin	2 n

β 53.

R. A. 19h 29m 49s
Decl. + 11° 11′

1891.709	248.3	1.52	8.8 . . 9.5	36
.711	249.6	1.35	9.0 . . 10.5	36
.731	250.9	1.42	8.7 . . 9.2	36
1891.72	249.6	1.43	8.8 . . 9.7	

Σ 2543.

R. A. 19h 30m 20s
Decl. + 5° 45′

1891.419	154.4	12.74	6.5 . . 10.8	36
.485	155.2	12.57	6.0 . . 9.0	36
.487	155.0	12.51	7.5 . . 9.5	12
1891.46	154.9	12.61	6.5 . . 9.8	

Very little change since STRUVE.

β 761.

R. A. 19h 31m 45s
Decl. — 39° 42′

1889.392	197.6	2.42	8.0 . . 10.0	12
.430	199.6	2.52	7.5 . . 10.5	12
.438	197.3	2.40	7.5 . . 10.0	12
1889.42	198.2	2.45	7.7 . . 10.2	

The following are all the measures:

1879.68	197.4	. . .	β	3 n
1886.71	198.7	2.55	Pol	1 n

β 249.

R. A. 19h 32m 13s
Decl. + 0° 4′

1891.709	136.3	1.36	7.3 . . . 9.0	36
.711	139.1	1.09	7.3 . . . 9.5	36
.731	136.9	1.25	7.5 . . . 9.5	36
1891.72	137.4	1.23	7.4 . . . 9.3	

β 1131. θ Cygni.

R. A. 19h 33m 13s
Decl. + 49° 56′

1892.383	47.0	3.79	. . 14.5	36

The companion has the same proper motion as the large star, and the two certainly form a physical pair. The first measures will be found in the list of new pairs.

β 977.

R. A. 19h 34m 19s
Decl. + 4° 4′

1891.633	57°.7	4″.26	8.0 . . 11.5	36
.636	55.8	4.02	8.3 . . 12.0	36
1891.63	56.7	4.14	8.1 . . 11.7	

Kustner 2.

R. A. 19h 35m 38s
Decl. + 71° 20′

1889.173	271°.9	1″.35	8.0 . . . 9.5	12
.312	272.9	1.45	6.5 . . . 8.5	36
.315	268.5	1.52	7.0 . . . 9.5	12
1889.27	271.1	1.44	7.2 . . . 9.2	

Discovered by KUSTNER with the Berlin Meridian Circle (A. N. 2756). So far as I am aware, it has not been measured before.

OΣ 380. χ Aquilae.

R. A. 19h 36m 55s
Decl. + 11° 33′

1889.592 I have never been able to see with any telescope the third star noted by some of the earlier observers. The 36-inch fails to show any other than the well-known components.

β 658. B.A.C. 6762.

R. A. 19h 39m 1s
Decl. + 26° 50′

1889.553	301°.8	0″.54	6.5 . . 10.0	36
.556	298.7	0.50	6.8 . . 9.5	36
.559	299.3	0.45	6.8 . . 9.5	36
1889.56	299.9	0.50	6.7 . . 9.7	

My previous measure is:

1878.53	295°.2	0″.57	β	1 n

A.G.C. 10.

R. A. 19h 39m 15s
Decl. + 10° 29′

A and B.

1890.594	143°.6	0″.24	8.5 . . . 8.6	36
.610	145.8	0.25	8.0 . . . 8.0	36
.630	146.0	0.22	8.3 . . . 8.5	36
1890.61	145.1	0.24	8.3 . . . 8.4	

AB and C (Σ 2570).

1890.594	275°.9	4″.33	. . . 9.7	36
.610	278.0	4.38	. . . 9.5	36
.630	279.0	4.20	. . . 9.0	36
1890.61	277.6	4.30	. . . 9.4	

The close pair was discovered by Mr. CLARK in 1875 with the 12-inch which is now at the LICK Observatory. There is no change in the Σ companion. The following are all the measures of AB:

1878.35	145°.5	0″.29	β	3 n
1880.22	147.6	0.29	β	3 n

β 468.

R. A. 19h 39m 58s
Decl. + 3° 57′

1891.633	182°.7	9″.95	7.0 . . 11.0	36
.636	183.3	9.67	6.3 . . 11.0	36
1891.63	183.0	9.81	6.6 . . 11.0	

No change since 1876.

β 55.

R. A. 19h 40m 30s
Decl. + 10° 16′

1891.711	28°.6	3″.70	9.7 . . . 9.8	36
.747	28.1	3.69	9.5 . . . 9.7	36
1891.73	28.3	3.69	9.6 . . . 9.7	

In a low-power field with *γ Aquilae*.

β 146.

R. A. 19h 40m 6s
Decl. — 20° 10′

1891.709	307°.9	0″.91	8.2 . . . 8.7	36
.731	311.7	0.98	8.0 . . . 9.3	36
.750	305.6	0.85	8.0 . . . 9.5	36
1891.73	308.4	0.91	8.1 . . . 9.2	

Slow motion in angle.

β 828.

R. A. 19h 41m 3s
Decl. + 5° 52′

1891.709	11°.1	2″.81	8.3 . . 9.5	36
.747	7.5	2.77	8.5 . . 11.0	36
.750	8.3	2.65	8.2 . . 10.0	36
1891.73	9.0	2.74	8.3 . . 10.2	

A.G.C. 11. ζ Sagittae.

R. A. $19^h\ 43^m\ 39^s$
Decl. $+\ 18^\circ\ 51'$

A and B.

1889.559	8.4	0.12	4.0 . . . 5.0	36
.592	1.6	0.12	4.0 . . . 4.0	36
1889.57	5.0	0.12	. . .	
1890.496	179.7	0.13	. . .	36
.537	175.7	0.12	. . .	36
.573	183.8	0.10	. . .	36
1890.53	179.7	0.12	. . .	
1891.597	182.4	0.17	5.0 . . . 7.0	36
.600	181.7	0.16	. . .	36
.641	184.2	0.13	5.0 . . . 6.0	36
1891.61	182.8	0.15	5.0 . . . 6.5	

This pair was also discovered with the 12-inch, now belonging to the LICK Observatory, by Mr. CLARK in 1875. It has now become a very close and difficult object. The change has been largely in distance. Special attention was given in the last measures to the proper quadrant for the smaller component. The angle found in 1889 should be increased 180°. This pair will have a moderately short period, but will always be a difficult object, as the maximum distance cannot much exceed 0″.3. The following are all the other measures:

1875.8	316.9	. . .	Δ	3 n
1878.11	157.6	0.29	β	5 n
1880.20	153.3	0.31	β	3 n
1883.41	176.6	0.17	En	8 n

It is much closer and more difficult now than formerly.

β 148.

R. A. $19^h\ 45^m\ 27^s$
Decl. $-\ 10^\circ\ 40'$

A and B.

1891.633	322.8	0.78	7.5 . . . 8.0	36
.636	323.8	0.78	7.3 . . . 7.5	36
1891.63	323.3	0.78	7.4 . . . 7.7	

A and C.

1891.633	65.0	26.22	. . 13.5	36
.636	64.5	26.42	. . 13.5	36
1891.63	64.7	26.32	. . 13.5	

β 659.

R. A. $19^h\ 48^m\ 48^s$
Decl. $+\ 6^\circ\ 50'$

1891.389	315.2	12.47	6.8 . . 12.0	36
.416	316.3	12.00	6.8 . . 13.0	36
.419	315.3	12.41	6.7 . . 11.5	36
.633	316.5	12.58	6.4 . . 13.0	36
.636	314.7	12.51	6.3 . . 13.0	36
1891.50	315.6	12.39	6.6 . . 12.5	

β 980. η Cygni.

R. A. $19^h\ 51^m\ 48^s$
Decl. $+\ 34^\circ\ 46'$

A and B.

1889.509	214.6	7.12	4.0 . . 13.0	36
.512	209.4	7.21	. . 13.0	36
.515	207.8	7.31	. . 13.0	36
.518	210.0	7.19	. . 12.5	36
1889.51	210.4	7.21	. . 13.0	

A and C (= *H* 1455).

1889.512	326.1	46.17	. . 11.2	36
.515	326.3	45.98	. . 10.7	36
1889.51	326.2	46.08	. . 11.0	

A and D (= *H* 1455).

1889.512	169.2	49.81	. . 11.0	36
.515	169.0	49.84	. . 10.5	36
1889.51	169.1	49.82	. . 10.7	

The only prior measure of the nearest star is:

1879.89	209.6	7.07	β	5 n

β 425.

R. A. $19^h\ 52^m\ 15^s$
Decl. $+\ 19^\circ\ 58'$

1891.490	242.0	1.20	8.5 . . . 8.6	12
.504	242.3	1.40	8.3 . . . 8.4	36
.518	242.1	1.29	8.3 . . . 8.4	36
1891.50	242.1	1.30	8.4 . . . 8.5	

β 981.

R. A. 19h 52m 40s
Decl. + 20° 13′

1891.504	109°.9	3″.31	8.3 . . 9.2	36
.518	109.5	3.32	8.1 . . 10.7	36
1891.51	109.7	3.32	8.2 . . 10.0	

Ho 276.

R. A. 19h 53m 16s
Decl. — 10° 16′

1890.655	Apparently single. First-class night.	12
.709	Nothing seen, but not the best seeing.	36

Described by HOUGH as elongated in the direction of 172°.9 (1887.75). This star has a large proper motion of 0″.507 in 221°.8.

*O*Σ 392.

R. A. 19h 53m 54s
Decl. + 41° 56′

A and B.

1890.675	305°.3	0″.28	7.0 . . . 8.5	36
.687	306.8	0.32	8.0 . . . 9.0	36
.689	306.4	0.28	7.0 . . . 8.0	36
1890.68	306.2	0.29	7.3 . . . 8.5	

A and C (Σ 2607).

1890.675	289°.9	3″.19	. . . 9.0	36
.687	293.0	3.19	. . . 9.0	36
.689	291.6	3.11	. . . 8.5	36
1890.68	291.5	3.16	. . .	

There is no change in Σ 2607 since 1831. There may be a little retrograde motion in the close pair, but it is only a few degrees at most since the first measures in 1844.

β 469.

R. A. 19h 54m 28s
Decl. + 24° 24′

1891.490	177°.6	14″.37	8.4 . . 11.0	12
.499	176.7	14.28	8.0 . . 10.8	36
.504	177.5	14.36	8.0 . . 10.5	36
1891.50	177.3	14.34	8.1 . . 10.8	

β 439.

R. A. 19h 55m 56s
Decl. + 29° 30′

1891.496	249°.1	3″.03	8.2 . . 13.5	12
.499	247.0	3.00	8.0 . . 13.5	36
.502	248.5	3.13	7.5 . . 11.0	36
1891.50	248.2	3.05	7.9 . . 12.7	

β 57.

R. A. 19h 59m 55s
Decl. + 15° 9′

1891.490	118°.9	2″.92	6.8 . . 12.0	12
.504	117.0	2.49	7.0 . . 10.5	36
.518	118.9	2.39	6.3 . . 11.5	36
1891.50	118.3	2.60	6.7 . . 11.3	

H 5178.

R. A. 20h 6m 0s
Decl. — 34° 29′

1891.523	12°.8	3″.07	7.5 . . . 8.2	12
.526	11.5	2.60	7.0 . . . 8.0	12
.531	11.5	2.85	7.3 . . . 8.6	12
1891.53	11.9	2.84	7.3 . . . 8.3	

Σ 2652.

R. A. 20h 7m 3s
Decl. + 61° 43′

1890.675	263°.6	0″.31	7.5 . . . 7.8	36
.687	263.3	0.31	7.5 . . . 7.6	36
.689	265.0	0.30	7.5 . . . 7.6	36
1890.68	264.0	0.31	7.5 . . . 7.7	

Certainly binary, but the motion is very slow. The angle has diminished only 19° since the measures of Σ in 1836, and the distance has remained nearly constant.

Ho 121.

R. A. 20h 7m 25s
Decl. + 34° 7′

A and B.

1889.425	17°.5	22″.19	7.5 . . 9.5	36
.430	17.6	22.80	7.5 . . 12.0	12
.436	17.4	22.28	7.0 . . 11.0	36
1889.43	17.5	22.42	7.3 . . 10.8	

A and C.

1889.425	14.0	41.54	. . 11.5	36
.436	15.1	41.58	. . 12.5	36
1889.43	14.5	41.56	. . 12.0	

Discovered by HOUGH. This star was measured in consequence of a note by BAKHUYZEN (*Bulletin Int. Phot. Congress*, III, 218), as follows:

"Le changement dans la position des deaux composantes de l'étoile double DM. + 34°.3916 (position pour 1875.0 $\alpha = 20^h\ 8^m\ 8^s$, $\delta = +34^\circ\ 6'\ 2''$), est fort interessant; je n'ai pu en trouver d'autres observations."

There is certainly no change in B, as Ho found:

1884.71	17.8	21.43	Ho	2 n

The distant star is only roughly given: 40°, 42".

β 762.

R. A. $20^h\ 9^m\ 21^s$
Decl. $-32^\circ\ 59'$

1891.523	302.0	2.46	8.0 . . . 8.3	12
.526	304.3	2.28	8.3 . . . 8.4	12
.531	303.6	2.33	8.0 . . . 8.2	12
1891.53	303.3	2.36	8.1 . . . 8.3	

β 294. 3 Capricorni.

R. A. $20^h\ 9^m\ 44^s$
Decl. $-12^\circ\ 42'$

A and B.

1891.633	35.9	27.19	5.5 . . .	36
.652	36.5	27.10	6.0 . . .	36
1891.64	36.2	27.14	5.7 . . .	

B and C.

1891.633	179.5	8.49	13.0 . . 13.6	36
.652	176.4	7.86	13.0 . . 13.5	36
1891.64	177.9	8.17	13.0 . . 13.5	

No other measures.

α^1 Capricorni.

R. A. $20^h\ 11^m\ 0^s$
Decl. $-12^\circ\ 53'$

A and B (= β 295).

1891.826	181.6	43.63	. . 13.5	36
.843	182.3	43.29	. . 13.5	36
1891.83	181.9	43.46	. . 13.5	

A and C (= *H* 607).

1891.826	221.2	44.89	. . . 9.0	36
.843	221.9	44.42	. . . 8.8	36
1891.83	221.5	44.65	. . . 8.9	

α^2 Capricorni.

R. A. $20^h\ 11^m\ 24^s$
Decl. $-12^\circ\ 55'$

B and C (A. G. CLARK).

1889.463	238.0	1.08	11.5 . . 11.7	36
.471	239.7	1.26	11.5 . . 11.6	36
.502	239.2	1.22	11.0 . . 11.1	36
1889.48	239.0	1.19	11.3 . . 11.5	

A and B (= *H* 608).

1889.463	145.7	7.86	. . .	36
.471	146.3	7.69	. . .	36
.502	148.5	7.70	. . .	36
1889.48	146.8	7.75	. . .	

The change, if any, in the close pair is very slow.

β 661. Cygni 166.

R. A. $20^h\ 12^m\ 39^s$
Decl. $+40^\circ\ 0'$

1891.499	65.7	12.80	6.0 . . 12.0	36
.502	65.2	13.06	5.5 . . 11.5	36
.518	64.5	13.12	6.0 . . 13.0	36
1891.50	65.1	12.99	5.8 . . 12.2	

β^1 Capricorni.

R. A. $20^h\ 14^m\ 2^s$
Decl. $-15^\circ\ 10'$

1888.644	114.5	0.90	. . 10.0	12
.652	100.3	0.66	. .	12
.655	101.8	0.73	. .	12
.714	107.0	1.08	. . 9.0	12
1888.66	105.9	0.84	. .	
1891.542	107.3	0.94	6.0 . . 10.5	36
.575	109.2	0.78	6.0 . . 10.0	36
.673	107.4	1.00	6.0 . . 10.5	36
1891.60	108.0	0.91	6.0 . . 10.3	

Discovered by BARNARD in 1883 during an occultation by the moon. The only other measures are:

1884.59	105°.8	0".85	β	3 n
1886.72	109.6	0.83	Ho	2 n

H 2948.

R. A. 20h 14m 15s
Decl. — 15° 10′

1891.655	322°.7	6".65	13.0 . . 13.5	36
.673	321.9	6.19	13.0 . . 13.3	36
1891.66	322.3	6.42	13.0 . . 13.4	

β^2 Capricorni and *H* 2948.

1891.655	294°.1	111".75	. .	36
.673	294.0	111.66	. .	36
1891.66	294.0	111.70	. .	

This is the faint pair a little north of the line joining β^1 and β^2 *Capricorni*. HERSCHEL'S description is: "A very minute star forming a triangle with β^1 and β^2 *Capricorni*. Pos. from $\beta^1 = 63°.4$; from $\beta^2 = 296°.0$. It is one of the most minute and delicate double stars I have seen." He called the magnitudes 17 and 18; position-angle 322°.2 and distance 3"±. There are no other measures.

β 431.

R. A. 20h 15m 25s
Decl. + 35° 53′

1889.523	41°.9	0".65	8.5 . . . 8.5	12
.526	33.3	0.70	8.5 . . . 8.5	12
.531	39.7	0.68	8.6 . . . 8.6	36
.534	38.1	0.60	8.7 . . . 8.7	36
1889.53	38.2	0.66	8.6 . . . 8.6	

Probably unchanged. The following are all the measures:

1877.33	220°.8	0".56	De	5 n
1884.84	53.1	0.42	En	7 n

β 763. κ^2 Sagittarii.

R. A. 20h 15m 45s
Decl. — 42° 48′

1889.430	209°.8	1".49	6.0 . . 8.5	12
.460	210.9	1.38	6.0 . . 9.0	12
.468	213.1	1.31	6.0 . . 10.0	12
.523	210.9	1.15	6.0 . . 8.0	12
1889.47	211.2	1.33	6.0 . . 8.9	

β 663.

R. A. 20h 17m 21s
Decl. + 53° 13′

A and B.

1891.537	310°.9	6".67	6.0 . . 15.0	36
.540	316.3	6.50	6.5 . . 15.5	36
1891.54	313.6	6.58	6.2 . . 15.2	

A and C.

1891.502	74°.8	7".80	6.5 . . 13.0	36
.537	75.8	7.70	6.0 . . 12.0	36
.540	75.0	7.51	6.5 . . 12.5	36
1891.53	75.2	7.67	6.3 . . 12.5	

The nearest star B was added with the 36-inch. It is exceedingly faint with the large instrument.

β 665. γ Cygni.

R. A. 20h 17m 55s
Decl. + 39° 52′

A and BC.

1891.502	195°.9	140".63	. .	36
.537	196.7	141.26	. .	36
.540	196.7	141.50	. .	36
1891.53	196.4	141.13	. .	

B and C.

1891.502	301°.2	1".85	9.6 . . 9.6	36
.537	301.9	1.78	10.5 . . 10.6	36
.540	303.0	1.70	11.0 . . 11.0	36
1891.53	302.0	1.78	10.4 . . 10.4	

There has been no change in the close pair since my measures of 1878. Several small stars nearer γ *Cygni* than this.

β 61. ρ Capricorni.

R. A. 20h 22m 1s
Decl. — 18° 13′

1891.485	150°.8	55".36	. . 13.0	36
.490	151.8	55.35	. . 13.5	36
.499	151.5	54.92	. . 13.0	36
1891.49	151.4	55.21	. . 13.2	

No other measures.

β 668. B.A.C. 7080.

R. A. $20^h\ 25^m\ 49^s$
Decl. $-\ 10^\circ\ 16'$

1890.556	24.8	4.80	7.0 . . 11.0	36
.573	24.1	4.74	6.7 . . 11.0	36
.575	26.0	4.87	6.7 . . 11.5	36
1890.57	25.0	4.80	6.8 . . 11.2	
1891.485	29.2	4.42	6.0 . . 11.0	36
.490	27.6	4.79	6.0 . . 12.0	36
.499	26.7	4.72	6.0 . . 11.5	36
1891.49	27.8	4.64	6.0 . . 11.5	

The large star has a proper motion of 0".286 in the direction of 66°.7. As this is common to both stars, they undoubtedly form a physical system. The following are all the measures:

1878.63	29.0	4.64	β	3 n
1881.67	26.1	4.99	β	4 n

β 151. β Delphini.

R. A. $20^h\ 31^m\ 55^s$
Decl. $+\ 14^\circ\ 11'$

A and B.

1888.592	306.4	0.28	. . .	12
.605	300.6	0.43	. . .	12
.613	327.1	0.35	. . .	12
.652	300.2	0.20	. . .	12
.655	323.9	0.16	. . .	12
.714	300.0	0.21	. . .	12
.723	312.8	0.37	. . .	12
1888.65	310.1	0.29	. . .	
1889.422	309.1	0.32	. . .	36
.502	315.8	0.32	. . .	36
.515	315.7	0.24	. . .	36
.520	314.6	0.35	. . .	36
.537	315.9	0.31	. . .	36
1889.50	314.2	0.31	. . .	
1890.447	322.7	0.50	. . .	36
.496	323.6	0.37	. . .	36
.499	324.4	0.57	. . .	36
.526	326.1	0.36	. . .	36
1890.49	324.2	0.45	. . .	
1891.389	326.6	0.38	. . .	36
.419	332.0	0.38	. . .	36
.449	332.4	0.33	. . .	36
.559	335.4	0.45	. . .	36
1891.45	331.6	0.38	. . .	
1892.364	339.4	0.39	. . .	36
.386	339.9	0.51	. . .	36
.400	337.7	0.62	. . .	36
.403	337.8	0.48	. . .	36
1892.39	338.7	0.50	. . .	

AB and C.

1888.813	116.6	27.00	. . .	36
.838	114.8	26.54	. . .	12
1888.82	115.7	26.77	. . .	
1890.447	117.2	26.78	. . .	36
.458	117.5	26.85	. . .	36
.479	117.2	27.05	. . .	36
1890.46	117.3	26.89	. . .	

A and D (= Σ 2704).

1888.813	332.8	36.57	. . .	36
.838	333.6	36.13	. . .	12
1888.82	333.2	36.35	. . .	

The distance of this rapid binary is increasing, and it will be comparatively easy to measure for a few years. The last computed orbit of sixteen years (*Celoria*, A. N. 2824) is certainly too short. It will probably be about twenty-eight years. (*Sidereal Messenger*, May, 1891.)

β 298. α Delphini.

R. A. $20^h\ 34^m\ 3^s$
Decl. $+\ 15^\circ\ 29'$

A and B.

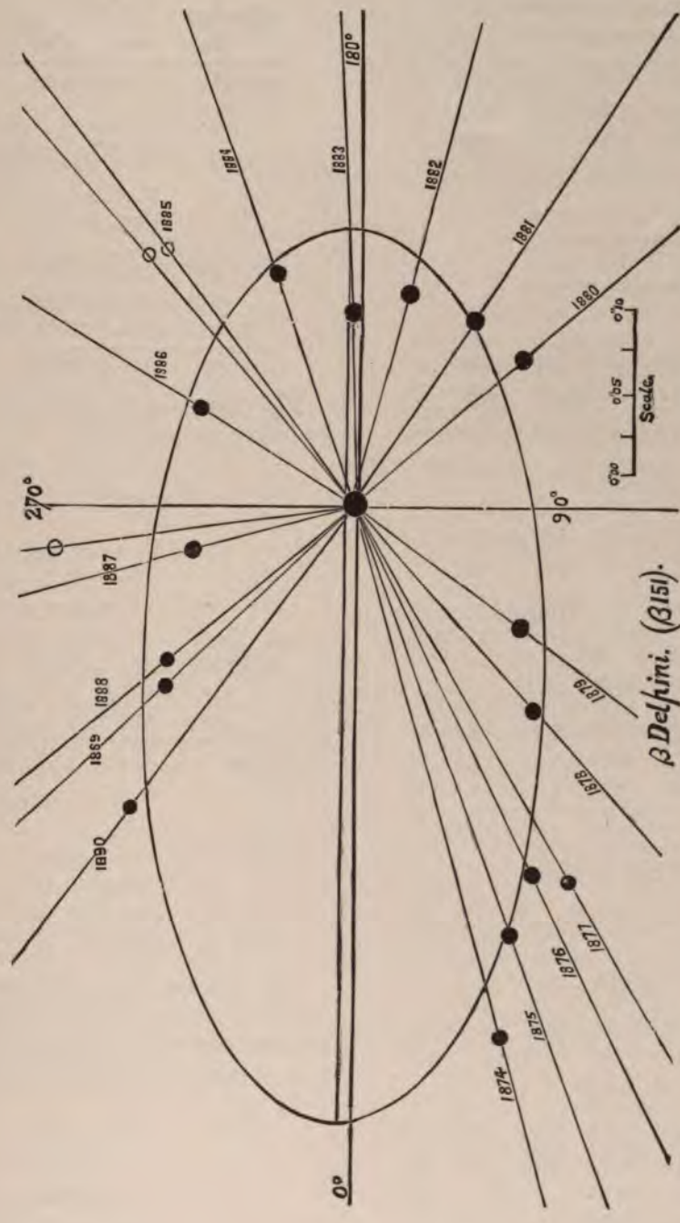
1891.689	224.0	28.87	. . 13.5	36
.728	223.6	28.92	. . 13.5	36
1891.70	223.8	28.90	. . 13.5	

A and C (= *H* 1554).

1891.689	280.1	43.84	. . 11.0	36
.728	281.0	43.79	. . 11.3	36
1891.70	280.5	43.81	. . 11.1	

A and D.

1891.689	150.5	47.70	. . 11.5	36
.728	151.1	48.20	. . 11.5	36
1891.70	150.8	47.95	. . 11.5	



A and E.

1891.689	309°.1	51".96	.. 13.0	36
.728	308.7	51.34	.. 12.5	36
1891.70	308.9	51.65	.. 12.7	

A and F.

1891.689	114°.3	79".66	.. 11.0	36
.728	115.0	79.92	.. 11.0	36
1891.70	114.6	79.79	.. 11.0	

β 288. Delphini 32.

R. A. $20^h\ 34^m\ 31^s$
Decl. $+15^\circ\ 25'$

1891.499	162°.5	7″.60	6.2 . . 13.0	36
.504	162.1	7.81	6.0 . . 13.5	36
.518	161.3	7.72	6.3 . . 13.0	36
1891.51	162.0	7.71	6.2 . . 13.2	

Ho 137.

R. A. $20^h\ 35^m\ 37^s$
Decl. $+29^\circ\ 23'$

1888.644	272°.5	1″.01	7.0 . . 10.0	12
.859	274.5	0.76	7.0 . . 10.0	12
1888.75	273.5	0.88	7.0 . . 10.0	

Discovered by HOUGH (A. N. 2779). He found:

1885.83	278°.9	1″.23	Ho	2 n

β 675. 51 Cygni.

R. A. $20^h\ 38^m\ 31^s$
Decl. $+49^\circ\ 54'$

1889.438	104°.2	3″.18	5.0 . . 13.5	36
.460	97.5	2.82	5.0 . . 12.5	36
.463	102.7	2.98	5.0 . . 13.5	36
1889.45	101.5	2.99	5.0 . . 13.2	

The only other measures are:

1878.24	101°.5	2″.78	β	3 n

β 64.

R. A. $20^h\ 39^m\ 18^s$
Decl. $+12^\circ\ 17'$

A and B.

1891.838	181°.6	0″.68	8.5 . . . 8.5	12
.840	177.0	0.65	8.5 . . . 8.5	12
.843	181.2	0.61	. . .	36
.845	181.4	0.65	8.0 . . . 8.1	36
1891.84	180.4	0.65	8.3 . . . 8.3	

AB and C (= *OΣ* App. 209).

1891.838	158°.3	96″.44	. . . 8.2	12
.840	158.1	96.75	. . . 8.4	12
.845	157.9	96.15	. . . 8.0	36
1891.84	158.1	96.45	. . . 8.2	

AB and D.

1891.843	118°.8	62″.06	. .	36
.845	119.0	62.39	. . 10.5	36
1891.84	118.9	62.22	. . 10.5	

β 676. ε Cygni.

R. A. $20^h\ 41^m\ 20^s$
Decl. $+33^\circ\ 31'$

1891.502	310°.0	38″.80	. . 13.0	36
.523	310.4	38.73	. . 13.0	36
.537	310.4	38.52	. . 13.0	36
1891.52	310.3	38.68	. . 13.0	

The change in the companion is probably due to proper motion.

β 677. *T* Cygni.

R. A. $20^h\ 42^m\ 23^s$
Decl. $+33^\circ\ 56'$

A and B.

1890.499	121°.2	9″.93	5.0 . . 12.5	36
.518	121.0	9.64	5.5 . . 12.0	36
.534	120.6	10.15	6.2 . . 12.0	36
1890.52	120.9	9.91	5.6 . . 12.2	

A and C.

1890.499	194°.5	12″.40	. . 13.5	36
.518	193.9	12.51	. . 13.0	36
.534	194.9	12.14	. . 13.5	36
1890.52	194.4	12.35	. . 13.3	

The principal star is *T Cygni* of the variable star catalogues. The second companion C is now observed for the first time. My original measures of B require a correction of 180° in the angle.

1878.41	121°.3	9″.66	β	1 n

β 367.

R. A. $20^h\ 49^m\ 53^s$
Decl. $+27^\circ\ 38'$

A and B.

1891.671	131°.3	0″.41	8.0 . . . 9.0	36
.673	128.2	0.40	8.0 . . . 8.6	36
.689	130.0	0.50	8.0 . . . 8.3	36
1891.68	129.8	0.44	8.0 . . . 8.6	

AB and C.

1891.671	24.2	31.49	. . 11.5	36
.673	24.0	31.43	. . 12.0	36
.689	23.9	31.59	. . 12.5	36
1891.68	24.0	31.50	. . 12.0	

The motion of the close pair has been about 15° since 1876.

Barnard. D.M. (3°) 4467.

R. A. $20^h\ 52^m\ 14^s$
Decl. $+\ 3°\ 29'$

A and B.

1891.818	86.4	1.34	10.0 . . 12.0	12
.824	85.8	1.46	9.7 . . 10.5	36
.840	82.0	1.45	10.5 . . 11.5	12
1891.83	84.7	1.42	10.1 . . 11.3	

A and C.

1891.818	252.2	23.55	. . 12.0	12
.824	251.1	23.40	. . 11.5	36
.840	251.0	23.43	. . 12.0	12
1891.83	251.4	23.46	. . 11.8	

Discovered by BARNARD with the 12-inch in October, 1891. It is near ε *Equulei*. The magnitude in D.M. is 9.0.

β 765.

R. A. $20^h\ 53^m\ 9^s$
Decl. $-\ 35°\ 45'$

1891.840	143.1	2.13	7.0 . . 13.0	12
.854	135.2	2.15	6.7 . . 11.0	36
.856	139.0	1.91	7.0 . . 13.0	12
1891.85	139.1	2.06	6.9 . . 12.3	

$O\Sigma$ 424.

R. A. $20^h\ 53^m\ 39^s$
Decl. $+\ 15°\ 6'$

A and B.

1891.826	326.3	0.40	8.0 . . . 9.5	36
.845	323.4	0.48	8.0 . . . 9.2	36
1891.83	324.8	0.44	8.0 . . . 9.3	

AB and C.

1891.826	306.2	34.17	. . 10.0	36

It has been supposed that the close pair was in rapid motion, but this may arise from placing the companion in the wrong quadrant. My measures in 1878–79 give substantially the same position as that now measured.

β 69.

R. A. $20^h\ 57^m\ 11^s$
Decl. $+\ 21°\ 13'$

A and B.

1891.838	317.2	0.86	8.5 . . . 9.7	12
.840	317.6	1.14	8.2 . . . 9.0	12
.843	314.8	0.86	8.2 . . . 9.0	36
1891.84	316.5	0.95	8.3 . . . 9.1	

A and C.

1891.838	239.1	77.83	. . . 8.3	12
.840	239.1	78.15	. . . 8.1	12
.843	238.7	77.65	. . . 8.0	36
1891.84	239.0	77.88	. . . 8.1	

C and D.

1891.843	154.6	19.47	. . 13.0	36

β 156.

R. A. $20^h\ 57^m\ 39^s$
Decl. $+\ 46°\ 6'$

1891.625	242.9	1.02	7.3 . . 10.0	12
.627	247.9	1.04	7.5 . . 10.0	12
.630	247.0	0.92	7.8 . . 9.8	12
1891.62	245.9	0.99	7.5 . . 9.9	

Secchi.

R. A. $20^h\ 58^m\ 43^s$
Decl. $+\ 3°\ 3'$

B and C.

1890.675	152.1	1.16	9.5 . . . 9.5	36
.678	148.8	1.17	9.0 . . . 9.0	36
.681	151.7	1.12	9.0 . . . 9.0	36
1890.68	150.9	1.15	9.2 . . . 9.2	
1892.400	153.3	1.10	8.7 . . . 8.7	36
.422	153.7	0.97	9.0 . . . 9.0	36
1892.41	153.5	1.03	8.8 . . . 8.8	

A and B (Σ 2749).

1890.675	155°.6	3″.11	7.5 . . .	36
.678	152.3	2.96	7.3 . . .	36
.681	155.6	3.01	7.7 . . .	36
1890.68	154.5	3.03	7.5 . . .	
1892.400	156.9	2.95	8.0 . . .	36
.422	155.7	3.00	8.0 . . .	36
1892.41	156.3	2.97	8.0 . . .	

The close pair was discovered by SECCHI in 1856. There has been some change.

1856.60	127°.0	0″.6	Se	
1863.88	141.7	0.8	De	1 n
1877.79	148.9	0.13	β	1 n

The STRUVE star has remained fixed.

β 70.

R. A. 20h 58m 52s
Decl. + 11° 33′

B and C.

1891.633	96°.7	5″.07	10.0 . . 10.2	36
.636	96.7	5.25	10.5 . . 10.6	36
1891.63	96.7	5.16	10.2 . . 10.4	

A and B.

1891.636	238°.9	78″.70	8.0 . .	36
.652	238.8	78.56	8.0 . .	36
1891.64	238.8	78.63	8.0 . .	

β 368. Aquarii 45.

R. A. 21h 1m 1s
Decl. — 8° 43′

A and B.

1890.630	89°.2	0″.64	7.0 . . . 7.5	36
.649	88.3	0.56	7.0 . . . 8.0	36
.652	88.6	0.53	6.7 . . . 7.8	36
1890.64	88.7	0.58	6.9 . . . 7.8	

C and D. (New.)

1890.630	317°.7	6″.09	14.0 . . 14.5	36
.673	318.1	6.20	14.0 . . 15.0	36
1890.65	317.9	6.15	14.0 . . 14.7	

AB and C.

1890.630	27°.5	12″.07	. .	36
.673	27.0	11.98	. .	36
1890.65	27.2	12.02	. .	

The close pair was discovered with the 6-inch in 1873. The large telescope shows a double companion not seen before. Slow retrograde motion in AB.

1876.78	97°.1	0″.55	De	5 n
1881.63	90.4	0.63	β	3 n

Σ 2758. 61 Cygni.

R. A. 21h 1m 14s
Decl. + 38° 8′

1889.463 Both stars single in the 36-
.502 inch, with powers up to 1,000.

1890.862	121°.0	21″.38	. . .	12
.867	121.9	21.17	. . .	12
.873	122.3	21.01	. . .	12
.876	122.3	21.02	. . .	12
1890.87	121.9	21.15	. . .	

An examination of the measures of the last sixty years shows, assuming the proper motion of A, 5″.196 in the direction of 51°.5, to be correct, that the proper motion of B is 5″.113 in the direction of 53°.5. The measures appear to show that this motion is uniform and rectilinear. (See *Sidereal Messenger*, January, 1891.)

β 679.

R. A. 21h 1m 25s
Decl. + 43° 12′

1889.436	67°.2	0″.58	10.0 . . 10.0	36
.438	67.1	0.47	10.0 . . 10.0	36
.463	62.4	0.51	10.0 . . 10.0	36
1889.45	65.6	0.52	10.0 . . 10.0	

One of the smallest close pairs known. It is too faint to be included in the D.M. I expected to find some motion, but the measures do not show it very clearly.

1878.10	68°.1	0″.38	β	2 n

Ho 149.

R. A. 21h 1m 26s
Decl. — 12° 10′

1888.714	328°.8	0″.81	8.0 . . . 8.4	12
.717	327.0	1.13	8.0 . . . 8.5	12
.731	325.3	0.86	8.3 . . . 8.7	12
.733	326.2	. . .	8.5 . . . 9.0	12
1888.72	326.8	0.90	8.2 . . . 8.7	

Discovered by HOUGH at Chicago. He makes the components equal, and gives:

1885.25	155°.4	0″.54	8.5 . . . 8.5	2 n

β 158.

R. A. 21h 1m 37s
Decl. + 47° 19′

1891.562	314°.1	10″.77	8.0 . . 11.0	36
.575	314.1	10.92	8.0 . . 11.5	36
1891.57	314.1	10.84	8.0 . . 11.2	

β 680.

R. A. 21h 1m 53s
Decl. + 53° 10′

A and B.

1891.644	307°.6	0″.65	8.5 . . . 9.0	12
.649	311.9	0.74	8.7 . . . 9.7	12
.671	310.7	0.53	8.1 . . . 8.8	36
1891.65	310.1	0.64	8.4 . . . 9.2	

A and C.

1891.655	32°.9	23″.35	. . 10.7	36
.671	32.7	23.27	. .	36
1891.66	32.8	23.31	. . 10.7	

β 836.

R. A. 21h 2m 27s
Decl. + 47° 54′

A and B.

1888.885	190°.2	0″.70	9.5 . . . 9.5	12
1889.422	194.2	0.66	9.0 . . . 9.0	36
.433	190.1	0.60	9.0 . . . 9.0	36
.436	191.3	0.58	9.0 . . . 9.0	36
1889.29	191.4	0.63	9.1 . . . 9.1	

C and D.

1888.885	241°.7	. . .	10.0 . .	12
1889.422	65.0	1.28	10.0 . . 11.0	36
.433	66.7	1.26	10.5 . . 11.5	36
.436	66.5	1.27	10.0 . . 11.0	36
1889.29	65.0	1.27	10.2 . . 11.2	

AB and C.

1888.885	220°.1	27″.13	. .	36
1889.422	219.7	27.46	. .	36
.433	219.2	27.64	. .	36
.436	218.8	27.59	. .	36
1889.29	219.4	27.45	. .	

The duplicity of C was suspected at the time of finding the other pair:

1881.63	191°.4	0″.62	β	3 n

γ Equulei.

R. A. 21h 4m 30s
Decl. + 9° 39′

A and B.

1888.813	276°.0	2″.37	. .	36
.821	274.3	1.90	. .	12
.835	275.9	2.14	. .	12
1888.82	275.4	2.14	. .	

A and C.

1888.813	8°.9	43″.26	. .	36
.821	11.2	43.41	. .	12
.835	7.6	43.31	. .	12
1888.82	9.2	43.33	. .	

Close star discovered by KNOTT. Apparently fixed.

1867.50	276°.8	2″.13	Knott.

Ho 283.

R. A. 21h 6m 14s
Decl. + 35° 49′

1890.649	Cannot see large star double. Good night.	36
.652	No close star seen.	36

Described by HOUGH, 178°± : 0″.8± : 6.8, 12. As there is a distant companion, there is no doubt of the identity of the star examined here.

β 159.

R. A. 21h 6m 21s
Decl. + 47° 12′

A and B.

1889.526	317°.3	1″.19	7.0 . . 10.0	12
.531	315.2	1.42	7.3 . . 9.0	36
.534	317.5	1.22	7.0 . . 10.0	36
1889.53	316.7	1.28	7.1 . . 9.7	

A and C (= $O\Sigma$ App. 215).

1889.526	189°.3	134".34	...7.5	12
.534	189.6	133.99	...7.2	36
1889.53	189.4	134.16	...7.3	

There is a faint star near AB, about 14" distant, in the direction of 147°. The principal stars seem to be relatively fixed:

1876.69	318°.4	1".33	De	7 n	AB
1875.72	189.6	134.14	De	4 n	AC

Ho 152.

R. A. 21h 7m 20s
Decl. + 27° 51′

1888.644	333°.7	0".69	8.5 . . . 9.0	12
.859	324.2	0.71	8.7 . . . 9.5	12
1888.75	328.9	0.70	8.6 . . . 9.2	

Discovered by HOUGH, who gives:

1882.66	320°.2	0".49	Ho	3 n

β 270. Equulei 19.

R. A. 21h 7m 31s
Decl. + 6° 43′

A and B.

1891.600	349°.2	0".65	7.0 . . . 8.5	36
.610	345.9	0.74	7.0 . . . 8.5	36
1891.60	347.5	0.70	7.0 . . . 8.5	

AB and C (= *S* 781).

1891.600	172°.7	184".49	...7.0	36
.610	172.5	184.55	...7.0	36
1891.60	172.6	184.52	... 7.0	

β 682.

R. A. 21h 8m 30s
Decl. + 4° 12′

1891.633	103°.2	5".53	7.5 . . 11.5	36
.636	103.3	5.73	8.0 . . 13.0	36
1891.63	103.3	5.63	7.7 . . 12.2	

$O\Sigma$ 535. δ Equulei.

R. A. 21h 8m 38s
Decl. + 9° 31′

1888.652	188°.7	0".24	...	12
.655	186.3	0.23	...	12
.714	190.0	0.29	...	12
.733	194.7	...	...	12
1888.69	189.9	0.25	...	

1889.515 Slight elongation with the 36-inch in the direction of 343°.2. Distance not more than 0".10.

1891.597	212°.0	0".19	...	36
.600	211.2	0.23	...	36
.655	210.6	0.17	...	36
.657	210.9	0.19	...	36
.673	213.4	0.20	...	36
1891.63	211.6	0.20	...	
1892.364	207.1	0.31	...	36
.386	205.6	0.35	...	36
.400	206.9	0.35	...	36
.403	206.7	0.41	...	36
1892.39	206.6	0.35	...	

The angle in the last two sets of measures should be diminished by 180° to conform to the orbit by WRUBLEWSKY (A.N. 2771). He finds a period of 11.48 years.

14 Aquarii.

R. A. 21h 9m 52s
Decl. — 9° 43′

1890.777 Certainly not double. 36
Fine seeing.

Discovered by DEMBOWSKI in 1875. He seems to have had some doubt as to whether the elongation measured was real. I have never been able to see it with any instrument, and hardly think it can be double.

A. G. Clark 13. τ Cygni.

R. A. 21h 10m 0s
Decl. + 37° 32′

A and B.

1888.733 Single, with all powers up to 3,300. Good definition.

1889.438	34°.4	0".63	.. 9.5	36
.502	31.0	0.58	.. 10.0	36
.509	32.3	0.42	.. 10.0	36
.515	36.5	0.38	.. 10.0	36
1889.49	36.5	0.50	.. 10.0	
1890.526	20.8	0.45	..	36
.537	21.3	0.66	..	36
.556	20.1	0.52	..	36
1890.54	20.5	0.54	..	
1891.419	12.2	0.64	..	36
.504	11.8	0.58	..	36
.540	13.1	0.61	..	36
1891.49	12.4	0.61	..	
1892.400	2.0	0.58	..	36
.403	3.9	0.64	..	36
.422	1.0	0.60	..	36
1892.40	2.3	0.61	..	

AB and C.

1889.312	247°.3	19".44	.. 13.5	36
.323	246.2	19.23	.. 13.0	36
1889.32	246.7	19.33	.. 13.2	
1890.496	245.4	19.65	..	36
.537	245.2	19.88	..	36
.556	245.5	19.80	..	36
1890.53	245.4	19.78	..	

The only other measure of C is by HALL, 260°.3 : 15".68 (1876.90) 1 n. The proper motion of A, according to AUWERS, is 0".48 in 17°.4, which appears to substantially account for the change in C. One of the most interesting of the binary stars, and now a difficult pair to measure. GORE, in 1886, found a period of 53.87 years. From latest measures, I get a period of 36.5 years. (See *Mon. Not.*, May, 1893.)

β 161.

R. A. 21h 10m 53s
Decl. — 4° 45′

B and C.

1891.633	318°.5	7".22	10.0 .. 11.5	36
.652	315.1	6.99	10.5 .. 11.5	36
1891.64	316.8	7.10	10.2 .. 11.5	

A and B.

1891.625	350°.3	101".25	8.0 .. 10.5	12
.627	350.1	101.07	8.0 .. 9.8	12
.630	350.1	100.72	8.3 .. 9.7	12
1891.62	350.2	101.01	8.1 .. 10.0	

The declination of this star in my *Third Catalogue* is 1° too large. There is a pair of very faint stars between A and B, but nearer the former.

A and *a*.

1891.652	315°.3	34".10	..	36

a and *b*.

1891.652	15°.8	11".66	13.5 .. 13.5	36

β 162.

R. A. 21h 12m 14s
Decl. + 35° 16′

1891.627	244°.2	1".09	8.5 ... 8.6	12
.630	244.8	1.03	8.5 ... 8.5	12
.649	241.6	1.16	8.5 ... 8.6	12
1891.63	243.5	1.09	8.5 ... 8.6	

Very little change since 1875.

β 163.

R. A. 21h 12m 47s
Decl. + 11° 4′

1891.499	252°.9	0".73	7.7 .. 9.0	36
.537	255.1	0.75	7.3 .. 10.0	36
.540	255.7	0.77	6.5 .. 10.5	36
1891.52	254.6	0.75	7.2 .. 9.8	

Distance decreasing. The components have a common proper motion.

β 271.

R. A. 21h 12m 49s
Decl. — 26° 51′

1891.523	238°.3	2".65	7.5 .. 10.8	12
.540	236.6	2.73	6.5 .. 10.5	36
.542	236.8	2.72	7.0 .. 10.0	36
1891.54	237.2	2.70	7.0 .. 10.4	

The principal star has a proper motion of 0".718 in the direction of 241°.3, and the companion has the same movement. Angle and distance increasing.

β 838.

R. A. $21^h\ 14^m\ 51^s$
Decl. $+\ 2^\circ\ 37'$

1891.854	99.°8	1.″32	8.3 . . . 9.0	36
.856	92.3	1.26	8.5 . . . 9.2	12
.859	98.0	1.44	8.1 . . . 9.3	36
1891.85	96.7	1.34	8.3 . . . 9.2	

Slow motion in angle.

OΣ 435.

R. A. $21^h\ 15^m\ 19^s$
Decl. $+\ 2^\circ\ 23'$

1891.854	212.°9	0.″58	8.2 . . . 8.3	36
.856	210.9	0.72	8.5 . . . 8.6	12
.859	210.4	0.66	8.5 . . . 8.6	36
1891.85	211.4	0.65	8.4 . . . 8.5	

No material change.

β 766. θ^a Microscopii.

R. A. $21^h\ 16^m\ 49^s$
Decl. $-41^\circ\ 31'$

1889.430	307.°1	1.″06	5.0 . . . 7.0	12

β 164.

R. A. $21^h\ 19^m\ 13^s$
Decl. $+\ 8^\circ\ 52'$

A and B.

1890.675	241.°3	0.″50	7.0 . . . 7.3	36
.681	239.5	0.51	7.8 . . . 8.0	36
.709	239.9	0.49	8.0 . . . 8.1	36
1890.69	240.2	0.50	7.6 . . . 7.8	

A and C (= Σ 2793).

1890.675	241.°4	27.″00	. . . 8.5	36
.681	241.4	27.00	. . . 9.0	36
.709	241.6	26.97	. . . 8.7	36
1890.69	241.5	26.99	. . . 8.7	

The close pair was discovered with the 6-inch, 1873. No sensible change in the Σ companion, and very little, if any, in the other since it has been observed.

1875.46	241.°6	0.″57	De	4 n

β 369.

R. A. $21^h\ 22^m\ 31^s$
Decl. $+\ 52^\circ\ 14'$

1891.502	31.°6	16.″01	7.2 . . 11.0	36
.504	32.2	16.40	7.7 . . 11.0	36
.518	32.0	16.38	7.0 . . 12.0	36
1891.50	31.9	16.26	7.3 . . 11.3	

There is a 14-m star a little farther than the companion measured, in the direction of 336°.

β 72.

R. A. $21^h\ 23^m\ 43^s$
Decl. $-\ 5^\circ\ 55'$

1890.675	40.°3	1.″90	8.3 . . . 8.7	36
.678	44.5	1.87	8.3 . . . 9.0	36
.681	41.8	1.76	8.3 . . . 9.0	36
1890.68	42.2	1.84	8.3 . . . 8.9	

No sensible change.

This pair and the next are in a low power field with *β Aquarii.*

1878.17	43.°1	1.″90	β	2 n

β 684.

R. A. $21^h\ 23^m\ 53^s$
Decl. $-\ 5^\circ\ 57'$

1890.675	128.°1	1.″20	8.7 . . . 9.0	36
.678	125.0	1.13	8.5 . . . 8.7	36
.681	127.1	1.03	8.8 . . . 9.0	36
1890.68	126.7	1.12	8.7 . . . 8.9	

Perhaps some angular motion:

1878.62	133.°9	1.″11	β	1 n

β 1212. 24 Aquarii.

R. A. $21^h\ 33^m\ 20^s$
Decl. $-\ 0^\circ\ 36'$

A and B.

1891.731	261.°7	0.″67	6.5 . . . 7.0	36
.750	259.2	0.58	6.0 . . . 7.0	36
.766	261.5	0.52	6.0 . . . 7.0	36
.772	261.7	0.43	6.8 . . . 7.5	36
1891.75	261.0	0.55	6.3 . . . 7.1	

AB and C.

	°	″		
1891.750	141.2	44.27	. . 11.0	36
.772	140.9	44.65	. . 10.8	36
1891.76	141.0	44.46	. . 10.9	

As this star has a proper motion of 0″.21, in the direction of 81°.5, the fact of its being a physical pair was established without any measures. The change in angle since last year is about 6°.

β 449.

R. A. 21h 34m 42s
Decl. + 41° 11′

A and B.

	°	″		
1891.502	15.3	6.02	7.0 . . 13.0	36
.504	15.4	6.16	7.0 . . 12.5	36
.537	16.2	6.10	7.3 . . 12.5	36
1891.51	15.6	6.09	7.1 . . 12.7	

A and C (= 0Σ 447).

	°	″		
1891.504	172.0	13.33	. . 10.2	36
.537	172.5	13.89	. . 11.8	36
1891.51	172.2	13.61	. . 11.0	

A and D.

	°	″		
1891.504	247.2	17.34	. . 12.3	36
.537	247.1	17.56	. . 12.0	36
1891.51	247.2	17.45	. . 12.1	

A and E (= 0Σ 447).

	°	″		
1891.502	44.5	28.93	. . 7.0	36
.504	44.5	29.02	. . 7.1	36
.537	44.9	28.90	. . 7.5	36
1891.51	44.6	28.95	. . 7.2	

Dawes.

R. A. 21h 34m 46s
Decl. + 42° 44′

	°	″		
1891.766	350.5	3.61	8.2 . . 10.5	36
.804	352.2	3.69	8.3 . . 11.0	36
1891.78	351.3	3.65	8.2 . . 10.7	

β 689. Aquarii 88.

R. A. 21h 38m 43s
Decl. + 2° 26′

	°	″		
1891.578	237.6	1.80	7.0 . . 11.0	36
.594	243.5	1.59	7.5 . . 11.5	36
.597	239.4	1.67	7.0 . . 12.0	36
.633	242.5	1.73	7.0 . . 11.0	36
.636	245.2	1.76	8.0 . . 11.5	36
1891.60	241.6	1.71	7.3 . . 11.4	

No material change since 1878.

β 989. x Pegasi.

R. A. 21h 39m 12s
Decl. + 25° 6′

A and B.

	°	″		
1888.711	270.7	0.33	. . .	12
.818	275.4	0.15	. . .	36
.824	278.0	0.22	. . .	36
1888.78	274.7	0.23	. . .	
1889.509	269.1	0.15	4.0 . . . 5.0	36
.512	256.1	0.16	5.0 . . . 5.5	36
.515	265.6	0.13	4.0 . . . 4.5	36
.526	258.3	0.12	4.0 . . . 5.0	36
1889.51	262.3	0.14	4.3 . . . 5.0	
1890.527	191.2	0.08	. . .	36
.573	176.5	0.10	. . .	36
.575	202.8	0.10	. . .	36
.610	178.0	0.10	. . .	36
1890.57	187.1	0.10	. . .	
1891.597	145.4	0.10	. . .	36
.600	153.6	0.11	. . .	36
.641	151.0	0.09	. . .	36
1891.61	150.0	0.10	. . .	
1891.785	145.1	0.16	. . .	36
.810	148.6	0.09	. . .	36
.818	144.3	0.15	. . .	36
.826	140.5	0.13	. . .	36
1891.81	144.6	0.13	. . .	
1892.364	135.1	0.17	. . .	36
.386	131.2	0.21	. . .	36
.400	132.3	0.15	. . .	36
.403	132.4	0.18	. . .	36
1892.39	132.8	0.18	. . .	

A and C (= Σ 2824).

1888.818	300.8	12.00	36
.824	300.7	12.43	36
1888.82	300.7	12.22	...

The Orbit of κ Pegasi (β 989).

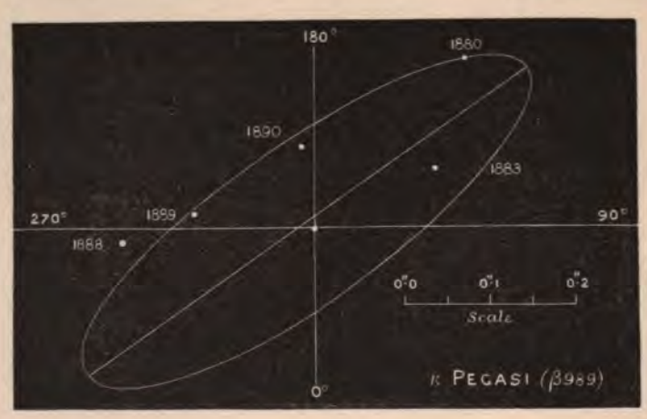
[From *Monthly Notices*, March, 1891.]

On August 12, 1880, while observing with the 18.5-inch refractor of the Dearborn Observatory, I came across the wide pair, κ *Pegasi*, and at once saw that the large star was a very close double. The measures made on this and following nights gave a distance of 0".27, and this I thought was more likely to be too large than otherwise (*Monthly Notices*, xli. p. 33). I was unable to give any further attention to this star until the commencement of my measures made at the Lick Observatory, and the extreme difficulty of measuring so close a pair seems to have deterred other observers, with a single exception, from doing anything with it. The only record of any other observation of any kind is found in the work of the late Dr. Engelmann, of Leipzig. When we consider that his telescope had an aperture of only about 7.5 inches, it is almost wonderful that he could get even an approximate position, notwithstanding it was a Clark objective, and shows his great skill as an observer, and the superior defining qualities of his instrument. It is unfortunate that we have so little to represent the extraordinary motion of this pair in a few years through an angle of 230°. Since I have been at Mount Hamilton I have measured the close pair each year with the 36-inch refractor. During the measures of the past year it was extremely difficult, and was a severe test of the power of the great telescope with the very best atmospheric conditions. The highest powers were, of course, used, and it was necessary, not only to exercise the utmost care in focusing, but to keep the head in such a position that the line joining the eyes was parallel to the line of the two stars.

The following are the measures of the close pair:

1880.68	137°.9	0".27	β	4 n
1883.02	116.0	0.16	En	1 n
1888.78	274.7	0.23	β	3 n
1889.51	262.3	0.14	β	4 n
1890.57	187.1	0.10	β	4 n

It is plain from the few observations already made that we have a binary system in very rapid motion. It is too soon, perhaps, to expect from the data given anything more than a very approximate solution of the orbit by any method of investigation, but a graphical representation of the measures will at least give a general idea of the relation between the components.



I have laid down these measures with all possible accuracy on a large scale (1"=20 inches), and then drawn after repeated trials the apparent ellipse shown on the accompanying diagram. This ellipse satisfies the test of equal areas in equal times. The areas described by the radius vector between the position of 1880–89 and 1889–90 are exactly proportional to the times (1:8.33); and as the variation of these positions from the path described by the curve is far within the ordinary errors of observation in a much easier star than this, I think the figure may be taken as a fair approximation to the apparent motion of the components. According to this

diagram, the distance at the time of ENGELMANN'S measure was 0".23, and the angle 113°; while for the position of 1888 the distance is 0".21, and the position-angle 281°. The other measures are substantially exact with reference to the assumed path of the secondary star. The components differ in brightness by something less than one magnitude, and when they are separated by only a quarter of a second, the difference is not very plain. It might be suspected that the angle of 1880 should be increased 180°, or that the measures of the last three years should be diminished by that amount. Upon referring to the original observations, I find that I took special pains to give the proper quadrant at the time of discovery, as well as in the measures of 1888 and 1889; so that I feel every confidence in the accuracy of the observations in this respect.

If this figure correctly represents the relative motions, it is evident that the period is shorter than that of any known star in the heavens. It should make one revolution in a little more than eleven years, and by the time it is observable again during the present year it should have nearly completed one revolution, and have about the same angle and distance as at the time of discovery in 1880.

From the projected orbit we get the following:

Major axis	0".636
Minor axis	0".187
Maximum distance	0".32 (1881.7)
Minimum distance	0".08 (1884.6)
Period	11.13 years.
Position-angle of major axis	125°.4

Apparently the real orbit is nearly circular, and makes an angle of about 75° with the line of sight. Whether the period of rotation is as short as that indicated, the motion is certainly very rapid, and the object one of the most interesting of its class. The measures which I hope to make during the coming summer will probably settle most of these questions. It should be comparatively easy to measure this year, as the distance will be not less than 0".2.

This star has been known as the wide double star since the time of Sir WILLIAM HERSCHEL, who detected the companion, a star of ninth magnitude, in 1786. He described it as "extremely unequal, the small star almost north, but a little preceding." It was not measured until 1831, when STRUVE observed it, and incorporated it in his great catalogue as Σ 2,824. The distance of the small star at that time was 11". It has been frequently measured since, the distance now being a little more than 12", with a very slow diminution of the position-angle. An examination of these measures shows beyond all question that the apparent motion of the small star is rectilinear and uniform. The displacement during the interval between STRUVE'S measures in 1831 and mine in 1888 amounts to 2".08 in the direction of 252°. This is undoubtedly the movement of the principal star, which has, therefore, an annual proper motion of 0".036 in the direction of 72°.

β 690. μ Cephei.

R. A. 21h 39m 50s
Decl. + 58° 14′

1889.520	259°.5	19".56	6.0 . . 13.0	36
.537	259.7	19.51	. . 13.0	36
.540	259.6	19.66	. . 13.5	36
1889.52	259.6	19.58	6.0 . . 13.2	

HERSCHEL'S variable "garnet star." The only other measures are:

1878.87	259°.4	19".16	β	3 n

H. A. Howe.

R. A. 21h 40m 57s
Decl. — 13° 42′

A and B.

1890.630	104°.6	0".70	8.0 . . . 9.0	36
.644	105.1	0.59	8.0 . . . 9.3	36
.652	104.4	0.64	8.0 . . . 9.0	36
1890.64	104.7	0.64	8.0 . . . 9.1	

A and C (= Σ 2826).

1890.630	82°.6	4".27	. . . 8.5	36
.644	81.5	4.28	. . . 8.7	36
.652	81.6	4.29	. . . 8.7	36
1890.64	81.9	4.28	. . . 8.6	

Probably unchanged:

1879.64	285°.0	0".8±	Cin	1 n

The STRUVE star is fixed.

β 768.

R. A. 21h 48m 33s
Decl. — 37° 52′

1891.627 No certain elongation with the 12-inch. Good seeing.

β 75.

R. A. 21h 49m 40s
Decl. + 10° 19′

1891.709	38°.4	1″.19	8.2 . . . 8.3	36
.733	39.6	1.11	8.0 . . . 8.2	36
.750	39.4	1.15	8.2 . . . 8.3	36
1891.73	39.1	1.15	8.1 . . . 8.3	

The angle is increasing.

β 275.

R. A. 21h 53m 38s
Decl. + 60° 43′

1890.675	2°.6	0″.44	7.7 . . . 8.0	36
.687	6.7	0.38	7.5 . . . 7.6	36
.689	2.1	0.34	7.5 . . . 8.0	36
1890.68	3.8	0.39	7.6 . . . 7.8	

The only other measures are:

1876.04	2°.7	0″.28	Δ	2 n
1888.86	5.4	0.35±	Sp	4 n

β 276. η Piscis Austrini.

R. A. 21h 53m 57s
Decl. — 29° 2′

1888.731	116°.3	1″.04	5.0 . . 5½	12
.782	119.7	. . .	6.0 . . 6.2	12
.793	118.7	1.98	. .	12
.796	119.3	1.80	. .	12
1888.78	118.5	1.61	. .	

Very little if any change.

β 694. Lacertae 4.

R. A. 21h 57m 6s
Decl. + 43° 54′

1891.709	358°.5	0″.70	6.7 . . . 9.0	36
.711	359.6	0.58	6.8 . . . 8.0	36
.731	357.4	0.65	6.5 . . . 7.8	36
1891.72	358.5	0.64	6.7 . . . 8.3	

The large telescope shows two distant companions, the first a 13-m star, 24″.1 distant in the direction of 328°.1; and the other 13.5-m, 27.″1 distant in the direction of 277°.3.

β 695.

R. A. 21h 58m 33s
Decl. + 60° 31′

1891.709	146°.0	2″.96	8.3 . . 11.0	36
.711	147.0	3.06	8.4 . . 11.0	36
.728	144.5	2.71	8.2 . . 10.5	36
1891.71	145.8	2.91	8.3 . . 10.8	

β 474.

R. A. 22h 1m 2s
Decl. + 60° 25′

1891.709	345°.2	16″.26	8.0 . . 12.0	36
.711	345.6	16.45	8.3 . . 12.0	36
.728	345.9	16.55	8.0 . . 11.5	36
1891.71	346.6	16.42	8.1 . . 11.8	

β 697. 19 Cephei.

R. A. 22h 1m 27s
Decl. + 61° 42′

1891.709	94°.0	19″.96	5.5 . . 11.5	36
.711	94.1	20.07	6.0 . . 11.5	36
.728	95.2	19.66	5.5 . . 11.5	36
1891.71	94.4	19.80	5.7 . . 11.5	

β 990.

R. A. 22h 1m 32s
Decl. + 62° 30′

1891.709	123°.6	0″.53	8.5 . . 10.0	36
.711	124.6	0.48	8.5 . . 10.5	36
.731	126.6	0.49	8.4 . . 9.0	36
1891.72	124.9	0.50	8.5 . . 9.8	

Leavenworth.

R. A. 22h 4m 8s
Decl. — 11° 40′

1890.802	164°.6	0″.93	9.2 . . . 9.3	36
.824	161.2	0.80	8.7 . . . 8.9	36
.840	166.3	0.82	9.0 . . . 9.1	36
1890.82	164.0	0.85	9.0 . . . 9.0	

Discovered by LEAVENWORTH at the McCORMICK Observatory. This star is SD. — 11°.5771.

1886.79	164°.6	0".93	L	2 n

β 375.

R. A. 22h 4m 29s
Decl. + 50° 11′

1891.709	305°.9	0".88	8.5 . . . 9.5	36
.731	307.9	0.89	8.5 . . . 9.0	36
1891.72	306.9	0.88	8.5 . . . 9.2	

β 769.

R. A. 22h 4m 37s
Decl. — 35° 3′

1891.854	350°.0	0".93	7.3 . . . 7.3	36
.856	353.2	0.97	8.0 . . . 8.5	12
.859	351.7	0.83	7.0 . . . 8.5	36
1891.85	351.6	0.91	7.4 . . . 8.1	

β 698.

R. A. 22h 5m 55s
Decl. + 6° 18′

1891.633	338°.0	10".64	6.7 . . 11.0	36
.636	337.8	10.46	7.0 . . 11.0	36
1891.63	337.9	10.55	6.8 . . 11.0	

β 475.

R. A. 22h 6m 15s
Decl. — 8° 36′

1891.826	228°.2	1".60	7.8 . . 11.5	36
.845	226.8	1.44	7.5 . . 10.5	36
.854	230.0	1.50	7.6 . . 9.3	36
1891.84	228.3	1.51	7.6 . . 10.4	

Ho 290.

R. A. 22h 6m 44s
Decl. + 57° 21′

A and B.

1890.649	No suspicion of Ho.'s star.	36
.655	Nothing seen. Magnificent seeing.	12
.675	No trace of any close star.	36

As a wide pair this star is β 436. In 1889 HOUGH measured a 11m star at a distance of 0".53 from A in the direction of 208°.5. There is no trace of any such star now.

β 699.

R. A. 22h 7m 45s
Decl. + 7° 7′

1891.709	184°.3	2".44	8.2 . . 11.5	36
.731	184.3	2.38	8.0 . . 12.0	36
.733	186.7	2.47	8.0 . . 12.5	36
1891.72	185.1	2.43	8.1 . . 12.0	

Σ 2578.

R. A. 22h 8m 31s
Decl. + 7° 23′

1891.711	124°.4	1".38	. .	36
.733	127.6	1.34	. .	36
1891.72	126.0	1.36	. .	

Σ 2881.

R. A. 22h 9m 6s
Decl. + 28° 59′

1890.499	100°.4	1".58	8.0 . . . 8.5	36
.518	99.7	1.64	8.0 . . . 8.3	36
.523	99.5	1.63	8.3 . . . 8.5	36
1890.51	99.9	1.62	8.1 . . . 8.4	

The change in this pair is very slow. The distance is about the same as it was in 1830, but the angle is 11° less.

β 377.

R. A. 22h 11m 22s
Decl. + 54° 4′

A and B.

1891.534	66°.0	64".24	8.0 . .	12
.537	65.8	63.75	8.0 . .	36
.540	66.0	63.64	8.0 . .	36
1891.54	65.9	63.88	8.0 . .	

B and C.

1891.534	301°.8	7".35	11.5 . . 12.5	12
.537	302.8	6.80	10.5 . . 11.0	36
.540	303.9	6.90	10.7 . . 10.9	36
1891.54	302.8	7.02	10.6 . . 11.5	

The large telescope shows six or eight stars nearer A than BC. Two of them form a faint pair, with distance a little less than BC, and 16″.5 from A in the direction of 263°.

β 379.

R. A. 22h 16m 0s
Decl. + 53° 13′

1891.644	335°.3	0″.92	8.5 . . . 8.7	12
.652	333.0	1.07	8.4 . . . 8.7	36
.655	332.9	1.08	8.2 . . . 8.5	36
1891.65	333.7	1.02	8.4 . . . 8.6	

No sensible change since 1877.

β 172. 51 Aquarii.

R. A. 22h 17m 52s
Decl. — 5° 27′

1891.578	11°.5	0″.72	5.5 . . . 5.5	36
.594	13.3	0.69	5.8 . . . 6.0	36
.597	11.5	0.64	5.5 . . . 5.6	36
1891.59	12.1	0.68	5.6 . . . 6.0	

Certainly a binary, but the motion is slow.

β 290. 34 Pegasi.

R. A. 22h 20m 30s
Decl. + 3° 47′

1889.589	218°.6	2″.85	6.0 . . 12.0	36
.633	218.7	2.59	6.0 . . 11.5	36
.673	218.7	2.70	5.5 . . 11.5	36
1889.63	218.7	2.71	5.8 . . 11.7	

Apparently unchanged:

1878.49	218°.9	2″.62	β	5 n

β 291.

R. A. 22h 21m 39s
Decl. + 3° 55′

1889.589	165°.0	0″.40	8.0 . . . 8.5	36
.633	170.3	0.49	8.5 . . . 8.7	36
.673	167.3	0.49	8.6 . . . 8.8	36
1889.63	167.5	0.46	8.4 . . . 8.7	

The following are the earlier measures:

1875.82	157°.8	0″.32	Δ	4 n
1878.64	160.0	0.42	β	1 n
1880.08	165.5	0.50	β	2 n

β 174.

R. A. 22h 22m 58s
Decl. — 10° 17′

1888.675	289°.7	8″.05	8.0 . . 10.5	12
.796	293.2	9.08	8.5 . . 10.5	12
.832	292.1	8.73	8.5 . . 11.0	12
1888.77	291.7	8.62	8.3 . . 10.7	

Dembowski made the distance 7″.38 in 1876, but later measures at Chicago and Cincinnati indicate substantially the value given above.

β 844.

R. A. 22h 23m 32s
Decl. + 5° 2′

B and C.

1891.859	316°.3	3″.26	9.5 . . 10.5	36
.862	316.0	3.33	10.0 . . 11.2	36
1891.86	316.1	3.30	9.7 . . 10.8	

A and B.

1891.859	34°.6	98″.44	8.0 . .	36
.862	34.1	98.05	8.2 . .	36
1891.86	34.3	98.25	8.1 . .	

No change in either component.

Σ 2912. 37 Pegasi.

R. A. 22h 23m 54s
Decl. + 3° 49′

1889.589	Single with 36-inch.		
1890.526	343°.8	0″.1 ±	36
.610	350.1	less than 0.1	36
1890.56	347.0		
1891.542	Round with 1,500.		
.597	Possibly a slight vertical elongation with 1,500, but uncertain.		
.785	Elongation, if any, is very slight and uncertain with 1,900. Perfect seeing.		

At the time of the single observation in 1889, this star could not have been really single, as appears from later observations; therefore, the angle in 1890 should be 167°.0. It was very carefully examined in 1891. (See *Astronomy and Astro-Physics*, Sept., 1893.)

β 703. α Lacertae.

R. A. $22^h\ 26^m\ 20^s$
Decl. $+\ 49°\ 49'$

1888.706	297.6	31.75	. . 13.0	12
.709	297.6	31.41	. . 11.5	12
.711	298.1	31.61	. . 12.0	12
1888.71	297.8	31.59	. . 12.2	

The only other measures are:

1878.02	298.8	30.16	β	2 n

β 770.

R. A. $22^h\ 27^m\ 47^s$
Decl. $-\ 23°\ 13'$

1891.876	351.3	1.49	8.5 . . 13.0	12
.882	358.1	1.24	8.0 . . 12.0	12
.893	349.0	1.35	8.0 . . 12.0	36
1891.88	352.8	1.36	8.2 . . 12.3	

No other measures.

β 381.

R. A. $22^h\ 27^m\ 22^s$
Decl. $+\ 32°\ 47'$

1891.644	234.8	1.39	8.7 . . 10.0	12
.649	229.5	1.42	8.3 . . 10.0	12
.652	233.7	1.52	8.5 . . 9.7	36
1891.65	232.7	1.44	8.5 . . 9.9	

β 77.

R. A. $22^h\ 27^m\ 51^s$
Decl. $-\ 2°\ 24'$

A and B.

1888.731	213.5	2.70	8.2 . . . 8.5	12
.733	213.0	2.96	8.5 . . . 8.7	12
.782	213.3	2.64	8.8 . . . 9.0	12
1888.75	213.3	2.77	8.5 . . . 8.7	

A and C.

1888.731	226.4	28.28	. . 11.0	12
.733	224.7	29.24	. . 10.8	12
.782	225.7	28.87	. . 11.5	12
1888.75	225.6	28.80	. . 11.0	

Probably without change.

β 706.

R. A. $22^h\ 28^m\ 21^s$
Decl. $+\ 67°\ 41'$

A and B.

1891.876	11.8	2.18	8.0 . . 12.5	12
.882	11.9	2.43	8.3 . . 13.0	12
1891.88	11.8	2.30	8.1 . . 12.7	

A and C.

1891.876	253.0	30.00	. . 11.5	12
.882	252.8	29.91	. . 12.0	12
1891.88	252.9	29.95	. . 11.7	

β 771. σ¹ Gruis.

R. A. $22^h\ 29^m\ 57^s$
Decl. $-\ 41°\ 13'$

1891.856	263.4	2.60	6.0 . . 13.0	12
.873	262.6	2.39	7.0 . . 13.0	12
.876	263.4	2.40	7.0 . . 13.0	12
1891.87	263.1	2.46	6.7 . . 13.0	

No other measures.

β 480.

R. A. $22^h\ 35^m\ 18^s$
Decl. $+\ 4°\ 6'$

1891.542	63.0	0.83	9.0 . . . 9.2	36
.562	63.6	0.70	8.8 . . . 9.2	36
.578	64.0	0.86	8.8 . . . 9.1	36
1891.56	63.5	0.80	8.9 . . . 9.2	

No material change.

β 710.

R. A. $22^h\ 36^m\ 56^s$
Decl. $+\ 29°\ 5'$

1891.731	233.8	0.37	8.2 . . . 8.4	36
.785	236.8	0.41	8.5 . . . 8.6	36
1891.76	235.3	0.39	8.3 . . . 8.5	

Difficult pair near *η Pegasi*. The distance is diminishing.

β 711.

R. A. 22h 39m 29s
Decl. + 10° 34′

1891.862	57°.1	0″.86	9.0 . . 10.0	36
.893	54.1	0.87	9.0 . . 10.0	36
.903	54.6	0.77	9.0 . . 9.7	36
1891.88	55.3	0.83	9.0 . . 9.9	

This pair appears to have retrograde motion.

β 451. 15 Lacertae.

R. A. 22h 46m 37s
Decl. + 42° 40′

1888.706	129°.3	29″.25	5.0 . . 12.0	12
.709	128.4	28.89	. . 12.0	12
.711	127.8	30.65	. . 12.0	12
1888.71	128.5	29.60	. . 12.0	

No other measures.

OΣ 482. B.A.C. 7990.

R. A. 22h 47m 55s
Decl. + 82° 31′

1889.293	32°.8	3″.64	5.0 . . 11.0	36
.312	38.3	3.23	. . 10.5	36
.323	36.5	3.34	5.5 . . 10.5	36
1889.31	35.9	3.40	5.2 . . 10.7	

Very little change. The following are all the previous measures:

1850.59	30°.2	3″.46	OΣ	6 n
1866.61	33.0	3.71	Δ	3 n

β 382. B.A.C. 7983.

R. A. 22h 48m 18s
Decl. + 44° 7′

A and B.

1889.523	215°.8	0″.94	7.5 . . . 9.0	12
.526	216.1	1.08	7.0 . . . 9.0	12
.534	220.9	0.94	7.3 . . . 8.5	36
1889.53	217.6	0.98	7.3 . . . 8.8	

A and C (= *H* 1828).

1889.526	353°.9	26″.99	. . 10.5	12
.534	353.6	26.86	. . 9.5	36
1889.53	353.7	26.92	. . 10.0	

Some evidence of motion in the close pair:

1876.39	205°.7	1″.07	De	7 n
1881.70	210.1	1.09	β	3 n

β 847.

R. A. 22h 48m 45s
Decl. + 19° 42′

1891.882	35°.5	6″.41	8.6 . . 10.7	12

Apparently fixed.

β 383.

R. A. 22h 49m 57s
Decl. + 8° 49′

A and B.

1891.788	116°.5	2″.46	8.0 . . 13.0	36
.804	120.0	2.54	8.0 . . 12.0	36
.810	119.6	2.74	8.0 . . 13.0	36
1891.80	118.7	2.58	8.0 . . 12.7	

A and C.

1891.788	237°.7	15″.07	. . 12.0	36
.804	239.6	15.76	. . 11.7	36
.810	239.8	15.46	. . 13.5	36
1891.80	239.0	15.43	. . 12.8	

β 772. δ Piscis Australis.

R. A. 22h 49m 18s
Decl. — 33° 11′

1891.882	237°.5	4″.91	5.0 . . 12.0	12
.884	239.5	4.72	5.0 . . 11.5	36
.893	242.2	4.70	5.0 . . 11.8	36
1891.88	239.7	4.78	5.0 . . 11.8	

Σ 2959.

R. A. 22h 50m 55s
Decl. — 3° 53′

A and B.

1891.815	103°.6	13″.17	7.0 . . 10.8	12
.824	103.2	13.42	7.8 . .	36
.826	103.0	13.34	8.0 . . 10.5	36
1891.82	103.3	13.31	7.6 . .	

B and C (= β 713).

1891.804	95°.2	10".07	9.0 . . 13.5	36
.824	92.0	10.15	9.0 . . 13.0	36
.826	95.0	10.33	. . 13.5	36
1891.82	94.1	10.18	. . 13.3	

OΣ 536. B.A.C. 8001.

R. A. 22h 52m 29s
Decl. + 8° 43′

1891.542	344°.6	0".15	7.5 . . . 7.5	36
.562	347.6	0.17	7.5 . . . 7.5	36
.597	342.3	0.14	7.0 . . . 7.2	36
1891.57	344.8	0.15	7.3 . . . 7.4	

There are but few measures of this pair. The distance has never exceeded 0".4, and as the stars are nearly the same magnitude, it is difficult to say from the measures whether there has been much change or not, except in distance. It may be in rapid motion. The plane of the orbit is probably nearly in the line of sight, and there may have been an occultation since the first measures in 1852.

Barnard. 2 Piscium.

R. A. 22h 53m 18s
Decl. + 0° 19′

1889.553	96°.0	3".87	6.0 . . 14.0	36
.556	91.8	3.88	6.0 . . 13.5	36
.589	93.1	3.68	6.0 . . 13.5	36
1889.57	93.6	3.81	6.0 . . 13.7	
1891.542	93.1	3.58	6.0 . . 13.5	36
.562	93.9	3.17	6.0 . . 13.5	36
.578	91.4	3.15	5.5 . . 13.0	36
.657	92.1	3.17	6.7 . . 13.8	36
1891.59	92.6	3.27	6.0 . . 13.4	

Discovered by BARNARD with the 12-inch of this observatory. The measures indicate a change in the distance.

β 481.

R. A. 22h 56m 23s
Decl. — 11° 53′

1891.862	54°.4	1".32	9.2 . . 9.3	36
.893	49.7	1.07	9.0 . . 10.0	36
.903	55.2	1.17	9.0 . . 9.6	36
1891.88	53.1	1.19	9.1 . . 9.6	

β 1147. 2 Andromedae.

R. A. 22h 57m 5s
Decl. + 42° 7′

1890.575	311°.0	0".27	5.5 . . 10.0	36
.610	311.1	0.30	. .	36
.675	316.9	0.25	5.0 . . 8.0	36
1890.62	313.0	0.27	5.2 . . 9.0	
1891.673	324.6	0.21	6.0 . . 8.5	36
.711	324.5	0.24	5.0 . . 8.5	36
.785	321.2	0.25	6.0 . . 8.5	36
1891.72	323.4	0.23	5.7 . . 8.5	

This is now an extremely difficult pair with the large telescope.

OΣ 487.

R. A. 22h 59m 10s
Decl. + 80° 8′

1890.673	206°.8	0".22	7.0 . . . 9.0	36
.687	211.5	0.12	6.8 . . . 8.5	36
.689	206.7	0.25	7.0 . . . 8.5	36
1890.68	208.3	0.20	6.9 . . . 8.7	
1891.673	211.3	0.19	7.5 . . . 8.7	36
.785	208.6	0.20	7.5 . . . 8.5	36

This close pair has never before been measured. It was seen elongated by OΣ from 1844 to 1858, the approximate angle being about 49°. (See A.N. 3017.)

θ Gruis.

R. A. 23h 0m 40s
Decl. — 44° 10′

1891.856	26°.9	2".25	5.0 . . . 8.5	12
.873	26.2	1.84	5.0 . . . 9.0	12
.876	25.3	2.16	5.5 . . . 8.7	12
1891.87	26.1	2.08	5.2 . . . 8.7	

β 1025.

R. A. 23h 1m 38s
Decl. + 12° 1′

A and B.

1891.562	267°.1	0".71	8.0 . . 11.0	36
.575	271.0	0.80	8.0 . . 11.0	36
.578	267.7	0.79	8.0 . . 10.5	36
1891.57	268.6	0.77	8.0 . . 10.8	

A and C.

1891.562	83.°7	22.″06	. . 12.0	36
.575	84.7	22.07	. . 12.0	36
.578	84.4	22.36	. . 11.8	36
1891.57	84.3	22.16	. . 11.9	

No other measures.

β 180.

R. A. 23h 2m 9s
Decl. + 60° 11′

A and B.

1890.633	175.°2	0.″63	8.0 . . . 9.2	36
.652	175.2	0.62	8.0 . . . 9.5	36
.673	175.3	0.62	8.0 . . . 9.0	36
1890.65	175.2	0.62	8.0 . . . 9.2	

A and C.

1890.633	106.°7	34.″25	. . . 9.3	36
.652	106.5	34.45	. . . 9.5	36
.673	106.5	34.59	. . . 9.5	36
1890.65	106.6	34.43	. . . 9.4	

The prior measures are:

1875.08	176.°8	0.″57	Δ	4 n
1875.54	106.3	34.30	Δ	2 n

β 385.

R. A. 23h 4m 31s
Decl. + 31° 50′

A and B.

1890.673	128.°9	0.″50	7.7 . . . 8.5	36
.687	130.2	0.46	7.5 . . . 7.8	36
.689	132.0	0.43	7.5 . . . 8.0	36
1890.68	130.4	0.46	7.6 . . . 8.1	

AB and C (= *H* 5532).

1890.673	77.°2	58.″09	. . . 9.0	36
.687	77.3	57.83	. . . 8.3	36
.689	77.4	58.16	. . . 9.0	36
1890.68	77.3	58.03	. . . 8.8	

H has no measures of the distant star.

1876.40	135.°8	0.″42	Δ	7 n
1885.46	143.2	0.41	En	4 n
1876.72	77.1	58.05	Δ	2 n

β 715. Aquarii 290.

R. A. 23h 8m 25s
Decl. — 11° 20′

1890.630	255.°8	3.″56	6.8 . . 11.7	36
.652	257.8	3.58	6.5 . . 12.0	36
.660	257.2	3.35	6.5 . . 11.5	36
1890.65	256.9	3.50	6.6 . . 11.7	

The Cincinnati observers in 1877 measured the large star as a close pair, 1°.5 : 0.″32. This was carefully looked for with the 36-inch in making the above measures, and there was no trace of any elongation at any time. There seems to be no change in the measured star:

1878.29	256.°0	3.″35	β	4 n

β 716.

R. A. 23h 9m 15s
Decl. — 9° 43′

1891.862	204.°2	1.″95	9.5 . . 9.8	36
.884	205.0	1.83	9.0 . . 9.7	36
.903	203.0	1.58	9.5 . . 10.5	36
1891.88	204.1	1.79	9.3 . . 10.0	

β 1220. ψ¹ Aquarii.

R. A. 23h 9m 35s
Decl. — 9° 44′

B and C.

1891.542	89.°3	0.″25	9.2 . . . 9.2	36
.575	100.0	0.17	9.5 . . . 9.5	36
.578	91.0	0.21	9.7 . . . 9.7	36
.600	277.0	0.24	9.7 . . . 9.8	36
1891.57	94.3	0.22	9.5 . . . 9.5	

At the time of the last measure the seeing was exceptionally fine, and the smaller star was placed on the preceding side, and therefore the mean result should perhaps be 274°.3. It is a difficult pair at all times.

A and D.

1891.884	274.°6	68.″59	. . 11.0	36
.903	274.7	68.31	. . 12.0	36
1891.89	274.6	68.45	. . 11.5	

BC and E.

1891.884	16.°0	19.″32	. . 12.0	36
.903	17.5	19.19	. . 13.0	36
1891.89	16.7	19.25	. . 12.5	

β 992.

R. A. 23h 10m 48s
Decl. + 63° 29′

1890.630	162°.0	0″.31	8.3 . . . 8.3	36
.633	163.2	0.37	8.3 . . . 8.3	36
.652	159.2	0.34	8.0 . . . 8.2	36
1890.64	161.5	0.34	8.2 . . . 8.3	

The only other measures are:

1880.59	170°.5	0″.41	β	5 n

β 182.

R. A. 23h 10m 54s
Decl. — 14° 27′

1891.578	51°.1	0″.52	8.3 . . . 8.3	36
.594	47.5	0.72	8.3 . . . 8.5	36
.597	47.7	0.66	8.3 . . . 8.3	36
1891.59	48.8	0.63	8.3 . . . 8.4	

This small star has a large proper motion, 1″.301 in the direction of 201°.4, and is therefore a binary. By virtue of this motion it has passed over 23″.4 since it was discovered, while the components have remained nearly fixed relatively.

β 79.

R. A. 23h 11m 24s
Decl. — 2° 10′

1891.490	94°.4	0″.94	8.0 . . . 9.0	36
.562	94.5	0.85	8.0 . . . 8.4	36
.575	95.0	0.84	8.0 . . . 8.4	36
1891.54	94.6	0.88	8.0 . . . 8.6	

To this star is assigned a proper motion of 0″.212 in the direction of 119°.7, and this is common to both stars. The position-angle is slowly diminishing.

β 717. 8 Andromedae.

R. A. 23h 12m 11s
Decl. + 48° 22′

1891.788	162°.9	7″.29	5.5 . . 12.0	36
.824	162.3	7.23	5.5 . . 13.0	36
.826	160.1	7.78	5.0 . . 13.0	36
1891.81	161.8	7.43	5.3 . . 12.7	

No change since 1878.

β 80.

R. A. 23h 12m 42s
Decl. + 4° 45′

1888.675	321°.6	0″.94	8.5 . . . 9.0	12
.711	319.0	0.99	8.0 . . . 9.0	12
.714	318.1	0.83	8.0 . . . 8.7	12
.731	319.4	0.92	8.3 . . . 8.8	12
1888.71	319.5	0.92	8.2 . . . 8.9	
1891.562	324.5	0.66	8.0 . . . 8.5	36
.575	321.4	0.66	8.0 . . . 8.7	36
.578	321.6	0.76	8.0 . . . 8.5	36
1891.57	322.5	0.69	8.0 . . . 8.6	

ARGELANDER gave the proper motion of this star 0″.558 in the direction of 101°.5. From a comparison of the above measures with the earlier observations, it is evident that it is a physical pair:

1875.80	300°.4	1″.07	Δ	4 n
1881.69	312.2	0.91	β	3 n

Ho 199. 95 Aquarii.

R. A. 23h 12m 43s
Decl. — 10° 16′

1888.714	223°.3	1″.31	4.0 . . 11.0	12
.717	226.0	1.13	. . 11.5	12
.736	219.0	1.21	. . 12.0	12
1888.72	222.8	1.22	. . 11.5	
1890.610	216.9	1.15	5.0 . . 13.0	36
.630	220.3	1.13	. . 11.5	36
.633	. . . .	1.16	. . 11.0	36
1890.62	218.6	1.15	. . 11.8	

HOUGH by a single measure gives:

1884.85	223°.5	1″.15	1 n

H 3184.

R. A. 23h 14m 38s
Decl. — 19° 12′

1891.882	283°.6	5″.19	8.0 . . 10.3	12
.893	284.7	5.10	8.0 . . 9.0	36
1891.88	284.1	5.15	8.1 . . 9.6	

Hough.

R. A. $23^h\ 14^m\ 43^s$
Decl. $+\ 1^\circ\ 48'$

B and C.

1891.540	215.2	0.75	11.0 . . 11.5	36
.562	214.0	0.75	11.0 . . 11.3	36
.575	215.6	0.90	10.0 . . 10.8	36
1891.56	214.9	0.80	10.7 . . 11.2	

A and B (= Σ 3002).

1891.540	201.3	3.77	7.8 . .	36
.562	202.9	3.80	8.0 . .	36
.575	202.1	3.83	8.0 . .	36
1891.56	202.1	3.80	7.9 . .	

The duplicity of the small star of Σ 3002 was discovered by HOUGH with the 18½-inch.

β 278.

R. A. $23^h\ 15^m\ 20^s$
Decl. $+\ 61^\circ\ 33'$

1890.630	174.0	12.68	6.5 . . 11.5	36
.633	173.7	12.62	6.5 . . 11.5	36
.652	173.9	12.69	6.8 . . 12.5	36
1890.64	173.9	12.66	6.6 . . 11.8	

No other measures.

β 718. 64 Pegasi.

R. A. $23^h\ 16^m\ 3^s$
Decl. $+\ 31^\circ\ 9'$

1888.711	93.4	0.51	5.5 . . . 7.0	12
.785	84.8	0.68	6.0 . . . 8.5	12
.851	81.9	0.92	. . .	12
.859	81.5	0.56	6.0 . . . 8.0	12
1888.80	85.4	0.67	5.8 . . . 7.8	
1889.473	85.9	0.70	5.5 . . . 9.0	12
.515	87.3	0.66	6.0 . . . 8.5	36
.523	85.3	0.70	6.0 . . . 9.0	12
1889.50	86.2	0.69	5.8 . . . 8.8	

Probably not much change. The only other measures are:

1878.70	86.9	0.46	β	3 n
1878.74	88.7	0.56	Δ	1 n
1888.73	85.8	0.63	Sp	3 n

Σ 3007.

R. A. $23^h\ 16^m\ 46^s$
Decl. $+\ 19^\circ\ 54'$

1891.540 A round with 1,500. Good seeing.

ENGELMANN thought the principal star was elongated.

Ho 300. 66 Pegasi.

R. A. $23^h\ 17^m\ 1^s$
Decl. $+\ 11^\circ\ 39'$

1890.652 Not the least trace of duplicity with 1,900.
1891.660 Absolutely round with 1,500. Fine definition.

According to Ho, this is an equal pair, elongated (1889.85) in the direction of 312°.1. I could see nothing to indicate this with any power on the 36-inch. The conditions were favorable.

β 719.

R. A. $23^h\ 18^m\ 22^s$
Decl. $+\ 13^\circ\ 49'$

1891.597	5.4	1.37	7.5 . . 11.5	36
.600	1.8	1.33	7.5 . . 11.5	36
.610	3.5	1.31	7.7 . . 11.5	36
1891.60	3.6	1.34	7.6 . . 11.5	

There is an error in the declination of this pair in the original catalogue. The correct place is given above. *Ho* 301 is identical with this pair.

β 386. B.A.C. 8173.

R. A. $23^h\ 21^m\ 12^s$
Decl. $+\ 70^\circ\ 1'$

1888.706	313.6	20.90	7.0 . . 11.5	12
.709	312.0	20.36	7.0 . . 11.0	12
.711	313.6	20.80	7.5 . . 11.0	12
1888.71	313.1	20.69	7.2 . . 11.2	

The only other measures are:

1876.97	312.3	20.08	Δ	4 n

Ho 200.

R. A. $23^h\ 24^m\ 19^s$
Decl. $+\ 85^\circ\ 45'$

1889.293	140°.5	2".35	7.0 . .	10.0	36
.312	143.1	2.44	6.5 . .	11.0	36
.323	144.1	2.36	6.3 . .	10.8	36
1889.31	142.6	2.38	6.6 . .	10.6	

The only other measures are:

1885.83	137°.7	1".73	Ho	2 n

OΣ 496. *P XXIII* 100.

R. A. $23^h\ 24^m\ 29^s$
Decl. $+\ 57^\circ\ 53'$

A and B.

1889.578	343°.5	1".22	6.0 . .	11.0	36
.583	339.2	1.39	. .		12
.589	343.6	1.22	6.0 . .	12.0	36
1889.58	342.1	1.28	6.0 . .	11.5	

C and D.

1889.578	226°.3	1".55	7.5 . . .	8.5	36
.583	224.9	1.61	. . .		12
.586	221.0	1.38	7.5 . . .	8.7	36
1889.58	224.1	1.51	7.5 . . .	8.6	

A and C.

1889.583	268°.9	75".56	. . .	12
.586	269.0	75.50	. . .	36
1889.59	269.0	75.53	. . .	

A small star 231".07 from A, in the direction of 207°.6, is a close double. It is given in the list of new pairs.

Σ 3022.

R. A. $23^h\ 25^m\ 7^s$
Decl. $+\ 57^\circ\ 45'$

1889.578	226°.4	20".28	8.5 . . .	8.8	36
.583	226.2	20.31	8.8 . . .	9.5	12
.586	226.2	20.49	8.5 . . .	9.0	36
1889.58	226.3	20.36	8.6 . . .	9.1	

Without change:

1832.15	226°.7	20".49	Σ	2 n

A tenth magnitude star 116."88 from A, in the direction of 189°.7, is a close double, and will be found in the list of new pairs.

β 774.

R. A. $23^h\ 25^m\ 18^s$
Decl. $+\ 63^\circ\ 40'$

1890.630	5°.9	0".46	8.5 . . .	8.8	36
.633	0.6	0.59	8.5 . . .	8.8	36
.652	5.7	0.52	8.0 . . .	8.2	36
1890.64	4.1	0.52	8.3 . . .	8.6	

Discovered with the 6-inch on Mt. Hamilton in 1879. The only other measures are:

1880.58	6°.7	0".51	β	3 n
1890.93	4.5	0.5±	Sp	1 n

β 720. 72 Pegasi.

R. A. $23^h\ 28^m\ 0^s$
Decl. $+\ 30^\circ\ 40'$

1889.473	145°.6	0".34	. . .		12
.515	144.9	0.37	6.0 . . .	6.0	36
.526	147.4	0.47	6.0 . . .	6.0	36
1889.50	146.0	0.38	6.0 . . .	6.0	
1890.526	147.8	0.32	. . .		36
.556	146.9	0.39	. . .		36
.564	150.1	0.41	. . .		36
1890.55	148.3	0.37	. . .		
1891.657	147.9	0.31	. . .		36
.673	150.8	0.40	. . .		36
.692	149.8	0.28	. . .		36
1891.67	149.5	0.33	. . .		

This is certainly a binary system. The following are some of the measures:

1878.74	127°.7	0".40	β	7 n
1878.74	128.7	0.37	Δ	1 n
1880.01	311.0	0.41	β	3 n
1883.40	147.6	0.25	En	7 n

β 387.

R. A. $23^h\ 28^m\ 8^s$
Decl. $-\ 10^\circ\ 22'$

1891.862	71°.3	5".84	8.3 . . .	8.8	36
.884	70.4	5.80	8.0 . . .	9.2	36
1891.87	70.8	5.82	8.1 . . .	9.0	

Without change.

β 723.

R. A. $23^h\ 34^m\ 32^s$
Decl. $-\ 0°\ 15'$

1891.769	166.°8	3.″70	7.0 . . 12.0	36
.772	168.1	3.62	7.3 . . 11.5	36
.785	168.6	3.66	7.0 . . 11.0	36
1891.77	167.8	3.66	7.1 . . 11.5	

No change since 1878.

β 724.

R. A. $23^h\ 34^m\ 46^s$
Decl. $+\ 7°\ 18'$

1891.769	88.°1	0.″71	8.5 . . . 9.0	36
.772	86.6	0.66	8.5 . . . 9.0	36
.785	87.5	0.55	9.0 . . . 9.2	36
1891.77	87.4	0.64	8.7 . . . 9.1	

β 858.

R. A. $23^h\ 35^m\ 18^s$
Decl. $+\ 31°\ 54'$

A and B.

1891.636	269.°3	0.″69	8.0 . . . 8.3	36
.638	268.6	0.62	8.0 . . . 8.2	36
1891.64	268.9	0.65	8.0 . . . 8.2	

The angle is diminishing.

AB and C (= β 389).

1891.636	52.°4	23.″37	. . 12.5	36
.638	51.9	23.12	. . 13.0	36
1891.64	52.1	23.24	. . 12.7	

β 279. ω² Aquarii.

R. A. $23^h\ 36^m\ 30^s$
Decl. $-\ 15°\ 12'$

1888.698	83.°2	5.″51	5.5 . . 11.5	12
.720	83.0	5.97	5.0 . . 10.8	12
.731	83.8	6.10	. . 11.0	12
1888.71	83.3	5.86	. . 11.0	

Probably unchanged.

1875.79	87.°8	5.″68	Δ	4 n

β 725.

R. A. $23^h\ 36^m\ 37^s$
Decl. $-\ 12°\ 0'$

1891.884	241.°7	4.″29	8.0 . . 12.0	36
.893	239.5	3.84	8.0 . . 13.0	36
.903	242.0	4.23	7.8 . . 12.5	36
1891.89	241.1	4.12	7.9 . . 12.5	

A.G.C. 14. 78 Pegasi.

R. A. $23^h\ 37^m\ 57^s$
Decl. $+\ 28°\ 42'$

1889.468	196.°0	1.″45	5.5 . . 10.0	12
.473	195.8	1.38	5.0 . . 9.0	12
.509	199.1	1.50	6.0 . . 10.0	36
1889.48	197.0	1.44	5.5 . . 9.7	

There may be a slight advance in the angle:

1876.59	192.°0	1.″45	Δ	4 n
1878.77	191.8	1.61	β	2 n

Barnard. W_1 $23^h.803$.

R. A. $23^h\ 40^m\ 53^s$
Decl. $+\ 4°\ 35'$

1889.553	166.°2	0.″49	8.7 . . . 8.7	36
.556	166.5	0.59	8.6 . . . 8.6	36
.589	166.0	0.53	8.5 . . . 8.5	36
1889.57	166.2	0.54	8.6 . . . 8.6	

Discovered with the 12-inch by Mr. E. E. BARNARD.

β 727.

R. A. $23^h\ 41^m\ 25^s$
Decl. $+\ 24°\ 55'$

1891.636	315.°7	16.″84	7.0 . . 13.5	36
.638	314.8	16.83	7.7 . . 13.5	36
1891.64	315.2	16.83	7.3 . . 13.5	

In my Tenth Catalogue, where this pair originally appeared, the printed distance should be multiplied by two. There is no sensible change since the measures of 1878.

β 995.

R. A. $23^h\ 41^m\ 35^s$
Decl. $+\ 46°\ 10'$

1889.468	244°.6	0".91	6.0 . . 10.0	12
.473	242.2	0.99	6.0 . . 9.5	12
.509	243.4	0.89	6.5 . . 11.0	36
1889.48	243.4	0.93	6.2 . . 10.2	
1891.692	241.6	0.78	6.7 . . 9.0	36
.772	238.8	0.70	6.5 . . 9.0	36
.785	238.9	0.84	7.0 . . 10.5	36
1891.75	239.8	0.77	6.7 . . 9.5	

The only other measures are:

1879.61	242°.0	0".68	Cin	1 n
1880.01	245.4	0.88	β	2 n

β 1013. δ Sculptoris.

R. A. $23^h\ 42^m\ 40^s$
Decl. $-\ 28°\ 48'$

A and B.

1891.636	229°.5	3".30	4.5 . . 12.0	36
.657	228.3	3.38	5.0 . . 13.0	36
1891.64	228.9	3.34	. . 12.5	

A and C (= *H* 3216).

1891.636	296°.8	73".78	. . . 8.7	36
.657	296.7	74.29	. . . 9.0	36
1891.64	296.7	74.03	. . . 8.8	

β 996.

R. A. $23^h\ 46^m\ 31^s$
Decl. $+\ 74°\ 53'$

1888.711	65°.2	5".53	7.0 . . 12.0	12
.733	68.7	5.16	7.5 . . 13.0	12
.785	67.4	5.60	7.0 . . 12.0	12
1888.74	67.1	5.43	7.2 . . 12.0	
1889.512	70.1	5.68	6.8 . . 13.0	12
.515	67.0	5.94	6.0 . . 13.0	36
.518	66.9	5.70	6.5 . . 11.5	36
1889.51	68.0	5.77	6.4 . . 12.5	

The only other measures are:

1880.64	64°.7	5".52	β	4 n
1888.74	67.1	5.43	β	3 n

The small star evidently has the same proper motion as the principal component, Radcl. 6203. This, according to ARGELANDER, is 0".298 in the direction of 88°.3.

β 729.

R. A. $23^h\ 49^m\ 15^s$
Decl. $-\ 18°\ 26'$

1891.893	344°.5	11".07	8.0 . . 12.0	36
.903	345.4	11.38	8.0 . . 13.5	36
1891.89	344.9	11.22	8.0 . . 12.7	

β 280.

R. A. $23^h\ 51^m\ 49^s$
Decl. $+\ 56°\ 43'$

A and C.

1891.791	191°.3	7".82	. . 12.0	36
.804	188.3	7.98	. . 12.5	36
1891.80	189.8	7.90	. . 12.2	

A and B (= Σ 3047).

1891.791	72°.6	0".87	8.2 . . . 8.3	36
.804	73.6	0.98	8.0 . . . 8.4	36
1891.80	73.1	0.92	8.1 . . . 8.4	

β 730. 27 Piscium.

R. A. $23^h\ 52^m\ 32^s$
Decl. $-\ 4°\ 13'$

1889.553	267°.8	1".52	4.5 . . 11.0	36
.556	266.7	1.59	5.5 . . 12.5	36
.594	267.6	1.39	5.0 . . 10.5	36
1889.57	267.4	1.50	5.0 . . 11.3	

For comparison we have:

1878.49	265°.2	1".49	β	5 n

β 732.

R. A. $23^h\ 54^m\ 18^s$
Decl. $+\ 7°\ 50'$

1891.862	154°.0	6".02	8.5 . . . 9.5	36
.884	151.9	5.88	8.5 . . . 9.5	36
1891.87	152.9	5.95	8.5 . . . 9.5	

β 482.

R. A. $23^h\ 55^m\ 44^s$
Decl. $+\ 62^\circ\ 39'$

A and B.

1888.706	344.°2	4.″61	9.0	10.0	12
.709	344.1	4.51	9.0	10.0	12
.711	343.1	4.67	9.0	10.0	12
1888.71	343.8	4.60	9.0	10.0	

A and C.

1888.706	126.°0	9.″99		11.0	12
.709	124.6	9.80		11.0	12
.711	121.1	9.57		11.5	12
1888.71	123.9	9.79		11.2	

DEMBOWSKI found:

1876.80	342.°7	4.″07	2 n

β 733. 85 Pegasi.

R. A. $23^h\ 55^m\ 52^s$
Decl. $+\ 26^\circ\ 27'$

A and B.

1888.668	123.°0	0.″84			36
.678	126.1	0.91			12
.681	132.0	0.97			12
.695	128.7	1.10			36
.711	123.9	0.91			12
1888.69	126.7	0.95			
1889.515	130.7	0.98		11.0	36
.523	132.2	0.97		11.0	36
.594	136.1	0.98		11.0	36
.633	138.3	0.85		11.5	36
.687	136.1	0.96		11.5	36
1889.59	134.7	0.94		11.2	
1890.526	138.1	0.73			36
.556	139.6	0.82			36
.564	137.2	0.80			36
.573	141.1	0.78			36
1890.55	139.0	0.78			
1891.537	150.4	0.79		11.0	36
.540	153.2	0.86		11.0	36
.600	151.7	0.73		11.0	36
1891.56	151.8	0.79		11.0	

A and C.

1888.652	1.°4	21.″47			12
.655	0.4	21.86			12
.663	0.5	22.04			12
.675	1.4	21.76			12
.695	0.9	21.40			36
1888.67	0.9	21.71			
1889.473	358.6	22.77			12
.509	359.0	22.68	6.0	9.0	36
.515	358.4	22.68		9.0	36
.523	358.8	22.54		9.0	36
1889.50	358.7	22.66			
1890.496	357.0	23.53			36
.499	356.7	23.56			36
.564	356.5	23.68			36
1890.52	356.7	23.59			
1891.540	354.8	24.38		9.0	36
.575	354.9	24.57		9.0	36
.600	354.3	24.79			36
1891.56	354.7	24.58			

The last orbit of this remarkable system is by GLASENAPP (A. N. 3145). He finds a period of 17.48 years. The time may be a year or two longer than this, but it is pretty certain that it will be less than twenty years. The following were made as the first of a series for parallax:

1891.903	354.°72	24.″977	$22^h\ 00$
.906	354.46	24.913	22:30
.925	354.28	25.017	22:30
.928	354.40	25.090	23:00
.944	354.37	25.091	22:50
.958	354.05	25.052	23:15
.969	354.18	24.930	23:15
.971	354.02	25.081	23:30
1891.94	354.31	25.019	

A and D.

1888.695	283.°8	72.″02		12.0	36
1891.887	285.1	74.36		13.5	36
.903	286.0	75.00		13.5	36
.906	284.9	75.77		13.0	36
.928	285.7	75.23		13.0	36
1891.90	285.4	75.09		13.2	

The change in the position of D corresponds to the proper motion of A as derived from the measures of C. The only other measures of this are:

1878.96	277°.1	61".73	β	1 n
1880.56	278.0	64.25	β	1 n

β 281.

R. A. $23^h\ 56^m\ 38^s$
Decl. $+\ 1°\ 28'$

A and B.

1891.594	208°.3	1".19	8.0 . . 10.0	36
.597	208.5	1.30	8.0 . . 10.0	36
.636	209.7	1.26	7.7 . . 10.5	36
1891.61	208.8	1.25	7.9 . . 10.2	

A and C (= *H* 998).

1891.594	334°.6	31".95	. . 11.0	36
.597	334.5	31.73	. . 11.8	36
.636	334.6	31.77	. . 13.0	36
1891.61	334.6	31.82	. . 11.9	

The angle of the close pair is decreasing.

Σ 3057.

R. A. $23^h\ 58^m\ 43^s$
Decl. $+\ 57°\ 52'$

1889.553	120°.0	3".62	6.6 . . . 8.8	36
.578	120.0	3.70	7.0 . . . 9.5	36
.589	120.2	3.65	6.7 . . . 9.0	36
1889.57	120.1	3.66	6.8 . . . 9.1	

The angle should be increased 180°.

Σ 3062.

R. A. $23^h\ 59^m\ 57^s$
Decl. $+\ 57°\ 46'$

1889.553	322°.1	1".33	6.5 . . . 7.5	36
.578	321.8	1.46	6.5 . . . 7.5	36
.583	319.5	1.55	6.6 . . . 7.5	12
1889.57	321.1	1.45	6.5 . . . 7.5	

MEASURES OF STARS NOTED AS DOUBLE

IN THE

CATALOGUES OF THE ASTRONOMISCHE GESELLSCHAFT.

MEASURES OF STARS

NOTED AS DOUBLE IN KRUEGER'S CATALOGUE OF THE ASTRONOMISCHE GESELLSCHAFT, ZONE 55° TO 65°.

In the recently published Catalog der Astronomischen Gesellschaft (Zone 55° to 65°), Professor KRUEGER has appended notes concerning such of the stars as appeared double in the meridian instrument. Many of these are, of course, identical with known double stars. I have carefully examined the entire list, and find that sixty-seven of these stars are not found in any of the double star catalogues. This number includes several doubtful cases where the duplicity was only suspected. I have looked up all of these stars, and measured such of them as were found to be double. As most of them are small stars, to avoid any uncertainty as to their identity I made a map of all the stars in ARGELANDER'S catalogue within one degree of the star to be examined. With a small platting scale this is done as rapidly as the places of the stars could be written down. When the map was compared with the finder, the star sought for was at once recognized. I think there can be no doubt that the proper star has been examined in every instance. The measures, except when otherwise noted, were made with the 12-inch refractor. The most of these pairs are probably too wide to make them likely to be of special interest, but some of them are close enough to form physical objects.

The following is a list of these stars, with KRUEGER'S notes as to the character of the pairs cited:

K	Star Catalogue.	α 1875.	δ 1875.	Magnitudes.	Notes.
1	74	$0^h\ 4^m\ 23^s$	57° 8′.5	9.1 . . . 9.2	2″–3″.
2	115	0 7 0	55 44.6	. . . 8.3	Dupl. 1″?
3	143	0 8 25	55 0.7	. . . 9.3	Dupl. seq. Com. 9.3.
4	201	0 12 29	59 0.7	. . . 8.4	Dupl. 2″–3″ bor. seq. Com. 9.1.
5	283	0 17 45	56 16.5	. . . 7.6	Com. 10 m. 1″.5?
6	349	0 21 49	61 48.9	. . . 8.7	Dupl. 1″?
7	382	0 23 31	59 0.4	. . . 9.3	Dupl. 4″ aust. Com. 9.5.
8	665	0 41 59	56 23.6	. . . 7.1	Dupl. 2″ seq. Com. 9.3.
9	956	1 1 42	60 52.6	. . . 7.1	Dupl. 2″? Com. 9 m.
10	998	1 4 13	60 31.2	. . . 8.9	Dupl. 3″ seq. Com. 9.4.
11	1,117	1 11 37	60 55.3	9.1 . . . 9.1	Dupl. 2″.

K	Star Catalogue.	α 1875.	δ 1875.	Magnitudes.	Notes.
12	1,484	$1^h\ 34^m\ 33^s$	62° 0'.7	. . . 8.1	Dupl.?
13	1,831	1 56 18	56 24.6	. . . 9.0	Dupl. 4″ aust seq. Com. 9.3.
14	2,384	2 29 17	63 10.3	. . . 8.9	Dupl. seq. Com. 9.5.
15	2,667	2 50 23	56 22.6	. . . 8.7	Dupl.?
16	2,670	2 50 24	57 9.6	. . . 7.0	Dupl. 1″.5 seq. Com. 9.3.
17	2,707	2 53 31	60 20.8	. . . 9.0	Dupl. 3″ bor. seq. Com. 9.2.
18	2,735	2 56 8	57 14.6	. . . 9.0	Dupl. 2″.
19	2,935	3 12 31	57 39.2	. . . 8.8	Dupl.?
20	3,028	3 21 19	55 31.4	. . . 9.3	Dupl. aust seq. Com. 9.5.
21	3,242	3 42 7	55 38.3	. . . 9.1	Dupl. 4″. Com. 9.4.
22	3,461	4 7 47	60 31.2	. . . 9.2	Dupl. 3″?
23	3,573	4 20 11	55 13.5	. . . 9.2	Dupl. 4″. Com. 9.6.
24	3,656	4 28 16	56 40.4	. . . 9.5	Dupl. 3″ pr.
25	3,815	4 47 3	56 26.5	. . . 9.1	Dupl. 3″?
26	3,992	5 11 36	55 47.7	. . . 9.5	Dupl. pr. Com. 9.5.
27	4,160	5 35 12	56 45.0	. . . 9.1	Dupl.?
28	4,567	6 23 24	59 17.3	. . . 8.5	Dupl. 1″?
29	4,839	6 50 24	57 1.3	. . . 9.3	Dupl. 6″ aust. Com. 9.5.
30	5,678	8 37 5	58 8.9	. . . 9.2	Dupl. 1″ seq.
31	5,684	8 38 36	63 39.3	. . . 9.4	Dupl. 6″ seq.
32	5,704	8 41 23	63 35.1	. . . 9.2	Dupl. 4″ aust. pr.
33	6,087	9 42 0	58 47.1	. . . 9.1	Dupl. 1″.
34	6,127	9 49 0	58 50.2	. . . 9.3	Dupl. pr. Com. 9.5.
35	6,225	10 0 59	55 58.9	. . . 9.2	Dupl. 9″. Com. 10 m.
36	6,318	10 14 33	62 14.6	. . . 9.3	Dupl. seq. Com. 9.7.
37	6,530	10 45 45	61 33.7	. . . 9.4	Dupl.?
38	6,801	11 25 48	60 45.4	9.2 . . . 9.2	Dupl. 2″.
39	6,807	11 26 19	58 29.7	. . . 9.0	Dupl. 10″ pr. Com. 9.6.
40	6,900	11 40 0	60 31.6	. . . 9.2	Dupl. 2″ seq. Com. 9.6.
41	7,413	12 57 19	57 5.5	. . . 8.8	Dupl. 4″ seq. Com. 9.5.
42	7,633	13 30 57	60 33 2	9.3 . . . 9.3	Dupl. 3″.
43	8,126	14 44 40	62 40.9	. . . 9.2	Dupl. 3″ bor. Com. 9.4.
44	9,009	16 48 25	56 32.4	. . . 7.9	Dupl. 2″.5? Com. 9.5?
45	9,146	17 5 31	56 19.7	. . . 7.8	Dupl. 1″.
46	9,221	17 17 37	58 39.3	. . . 8.9	Dupl.? 1″.5.
47	9,522	17 51 39	64 15.8	. . . 9.1	Dupl.
48	10,935	19 53 32	58 30.7	. . . 5.0	Dupl. 2″. Com. 8.5.
49	11,231	20 13 22	55 18.7	9.5 . . . 9.5	Dupl. 1″.5.
50	11,252	20 14 54	56 53.7	. . . 8.3	Dupl. 4″. Com. 9.2.
51	11,614	20 41 31	58 34.6	. . . 8.6	Dupl. 1″ bor. Com. 9.3.
52	11,640	20 43 52	55 39.2	. . . 9.4	Dupl. 4″. Com. 9.5.
53	11,809	20 56 0	55 27.2	. . . 6.4	Dupl. 3″ aust. Com. 7.8.
54	12,370	21 33 38	58 26.5	. . . 9.2	Dupl. 12″. Com. 9.5.
55	12,567	21 46 51	55 46.2	. . . 9.1	Dupl.
56	12,593	21 48 27	61 31.5	. . . 9.0	Dupl. 4″ aust. seq. Com. 9.5.
57	13,018	22 12 38	61 24.9	. . . 9.0	Dupl.
58	13,077	22 16 15	59 14.6	. . . 9.1	Dupl.?
59	13,155	22 22 43	63 4.9	. . . 8.6	Dupl. 2″.
60	13,170	22 23 32	57 4.3	. . . 9.1	Dupl. 12″ pr. Com. 9.3.
61	13,262	22 29 37	57 33.8	. . . 9.4	Dupl.
62	13,727	23 0 12	62 43.3	9.1 . . . 9.1	Dupl. 5″.
63	13,901	23 11 5	61 16.9	. . . 6.8	Dupl.?
64	13,912	23 12 1	55 1.2	. . . 9.3	Dupl. 2″ seq.
65	14,171	23 28 14	59 5.4	. . . 9.1	Dupl. pr. Com. 9.4.
66	14,208	23 31 56	60 0.8	. . . 9.2	Dupl.?
67	14,673	23 59 33	60 10.3	. . . 9.0	Dupl. 3″ bor. Com. 9.4.

The following are the measures of these stars, with the current numbers given in the preceding list:

MEASURES.

K.	1890 +	P.	D.	Magnitudes.	Notes.
1	0.763	189°.9	1″.70	9.2 . . 9.5	Measures with 36-inch.
2	0.769	. . .	. . .	. .	Not double. Good seeing.
3	0.763	44.1	3.43	9.0 . . 9.0	Measures with 36-inch.
4	0.763	192.4	1.85	8.5 . . 9.0	The 8½ᵐ star p is a close, unequal pair. Measures with 36-inch.
5	0.769	. . .	. . .	. .	Certainly not double. K's description applies to *OΣ* 9, 1ᵐ 38ˢ f and 10′ s.
6	0.780	. . .	. . .	. .	Not double. Good night.
7	0.763	10.4	3.50	9.5 . . 9.7	Measures with 36-inch.
8	0.769	. . .	. . .	. .	Not double.
9	0.780	. . .	. . .	. .	Not double. *β* 258 is near.
10	0.772	280.9	3.35	9.5 . . 10.5	
11	0.772	239.1	1.77	9.3 . . 9.3	
12	0.747	303.3	0.63	7.7 . . 7.7	No. 1484 is not double. The pair measured is 1ᵐ 35ˢ p, and 1′ 54″ n. I have assumed that K's note belongs to this star (No. 1455). Measures with 36-inch.
13	0.772	343.5	3.94	9.2 . . 9.5	
14	0.769	288.5	11.66	9.3 . . 10.0	
15	0.747	109.7	3.53	9.0 . . 9.7	Measures with 36-inch.
16	0.747	. . .	. . .	. .	Not double. 36-inch.
17	0.747	221.3	3.46	9.0 . . 9.1	Measures with 36-inch.
18	0.747	273.9	1.18	9.2 . . 9.3	Measures with 36-inch.
19	0.769	. . .	. . .	. .	Not double.
20	0.769	295.9	7.44	9.5 . . 9.7	
21	0.769	278.2	4.36	9.8 . . 10.0	
22	0.772	183.9	3.39	9.3 . . 9.4	
23	0.772	132.0	4.15	9.0 . . 9.3	
24	0.772	238.7	3.54	9.5 . . 9.5	
25	0.772	109.5	2.65	9.0 . . 9.5	
26	0.772	71.0	9.75	9.3 . . 9.5	
27	0.772	326.2	2.30	8.6 . . 10.0	
28	0.772	. . .	. . .	. .	Certainly not double. Good seeing.
29	1.214	357.1	6.37	9.0 . . 9.1	
30	1.118	117.1	1.45	9.5 . . 9.5	
31	1.118	278.4	6.91	9.5 . . 9.8	
32	1.118	190.3	4.40	9.0 . . 9.0	
33	1.222	215.3	1.85	9.0 . . 9.0	
34	1.222	63.0	36.20	9.2 . . 9.5	
35	1.222	. . .	. . .	. .	Certainly no companion.
36	1.222	244.9	5.17	9.0 . . 10.0	
37	1.296	. . .	. . .	. .	Not double.
38	1.291	54.3	2.60	9.0 . . 9.2	
39	1.296	156.2	10.74	9.0 . . 9.3	
40	1.291	273.3	2.88	9.2 . . 9.5	
41	1.291	336.9	3.40	9.0 . . 9.4	
42	1.296	217.4	3.81	9.5 . . 9.6	
43	1.296	215.9	2.70	9.7 . . 10.0	
44	0.769	. . .	. . .	. .	Not seen double. Magnitude est. 8.7.
45	0.769	. . .	. . .	. .	No signs of duplicity.
46	0.769	60.7	1.54	8.8 . . 9.0	
47	0.769	25.6	7.32	9.5 . . 10.5	

K.	1890 +	P.	D.	Magnitudes.	Notes.
48	0.769	. . .	. . .	. .	No trace of any companion to this bright star.
49	0.769	114°.3	1″.83	9.5 . . 9.7	
50	0.747	310.7	2.21	9.0 . . 9.5	
51	0.780	181.5	1.17	9.0 . . 10.0	
52	0.780	66.4	4.69	9.0 . . 9.2	
53	0.782	. . .	. . .	. .	Certainly not double. 36-inch.
54	0.782	129.2	16.36	9.0 . . 9.1	With 36-inch.
55	0.782	355.8	4.79	9.0 . . 9.1	A 10-m star: 21°: 17″. 36-inch.
56	0.788	302.1	4.49	9.0 . . 9.3	
57	0.788	221.8	1.22	9.0 . . 9.1	
58	0.788	28.0	1.55	9.0 . . 9.1	
59	0.747	165.7	1.59	9.0 . . 9.2	
60	0.788	178.8	2.32	9.0 . . 12.0	AB } A much nearer star is also measured.
	. . .	56.3	26.82	. . 9.2	AC }
61	0.788	115.1	3.91	9.3 . . 9.7	
62	0.763	323.8	5.10	9.0 . . 9.1	With 36-inch.
63	0.785	. . .	. . .	. .	Certainly not double. Good seeing, 36-inch. β 853 is 9′ n.
64	0.763	239.3	1.74	9.4 . . 9.5	Measures with 36-inch.
65	0.763	95.2	6.73	9.5 . . 9.7	Measures with 36-inch.
66	0.769	. . .	. . .	. .	No indication of duplicity.
67	0.763	159.4	2.71	9.0 . . 9.2	With 36-inch.

Zusatz. In der Einleitung zum Zonencatalog pag. (8) habe ich angeführt, dass die Originalbemerkungen über nahestehende Sterne meist nur in grosser Eile notirt werden konnten; dies betrifft auch besonders die Duplicität der Sterne, welche oft nicht sicher constatirt werden konnte. Es ist deshalb durchaus nicht befremdend, wenn solche Sterne, die mit "dupl.?" bezeichnet sind, bei genauerer Prüfung sich als einfach herausgestellt haben. Dazu kommt noch dass das Objectiv die Bilder hellerer Sterne etwas undeutlich, mit einem kurzen Schweif zeigte. Ich hatte vergeblich versucht, diesen Fehler zu beseitigen; nachdem ich die beiden Linsen aus der Fassung herausgenommen und mit neuen Staniolblättchen wieder auf einander gelegt hatte, war die Unregelmässigkeit noch nicht ganz gehoben.

Zu den Noten in Hrn. Burnham's Measures erlaube ich mir noch folgende Bemerkungen zuzufügen:

Nr.	Cat. Nr.	
5	283	Die Zonenbemerkung "dupl.?" kann nicht gut auf $O\Sigma$ 9 bezogen werden.
12	1,484	Auch hier ist es mir unwahrscheinlich, dass die Bemerkung "dupl." zu dem in der Nähe vorhandenen Doppelstern gehört; letzerer ist nach Hrn. Burnham's Messung zu eng.
16	2,670	Die Bemerkung "dupl." findet sich bei beiden Originalbeobachtungen.
35	6,225	Die Originalbemerkung in Zone 51 ist deutlich; sie fehlt aber in Zone 49.
48	10,935	In Zone 244 (nicht 249) ist die Bemerkung "dupl." deutlich; sie fehlt in der zweiten Beobachtung Zone 249.
53	11,809	Die Bemerkung gehört zum Sterne 11,843; Versehen in dem Catalog.

KIEL, *1891, Juni 3.* A. KRUEGER.

MEASURES OF STARS

NOTED AS DOUBLE IN THE CATALOGUE OF THE ASTRONOMISCHE GESELLSCHAFT, ZONE 65° TO 70°.

A considerable number of small stars have been noted as double in the course of the meridian observations at Christiania by the observers, Messrs. FEARNLEY and GEELMUYDEN. These are all wide pairs, and perhaps not likely to be of much interest as double stars, but it seemed worth while to connect them by micrometrical measures for the purpose of detecting any change from proper motion hereafter.

The method of examination and identification, referred to in the previous Zone Catalogue, has been followed here. The following is a list of the pairs not found in the double star catalogues, with the notes of the meridian observers:

No.	Star Catalogue.	α 1875.	δ 1875.	Magnitudes.	Notes.
1	160	$0^h\ 45^m\ 40^s.9$	67° 54′ 20″	9.0 . . . 9.2	40°: 12″.
2	163	0 46 22.4	68 22 9	9.1 . . . 9.4	80°: 8″.
3	617	3 29 3.0	66 32 17	8.9 . . .	Dupl.?
4	624	3 34 19.4	65 42 3	9.3 . . . 9.4	50°: 3″.
5	779	4 38 18.2	66 22 59	9.2 . . . 9.5	70°: 3″.
6	1,540	9 42 46.1	67 50 23	8.3 . . .	Com. deb. A 2″.5 (?).
7	1,748	11 15 34.4	65 24 15	9.5 . . .	Dupl.?
8	2,179	14 36 37.5	68 33 38	8.8 . . .	Dupl.?
9	2,532	16 44 35.2	67 0 6	9.0 . . . 9.5	155°: 3″.
10	3,000	19 17 30.6	69 34 43	9.0 . . .	Dupl.
11	3,089	19 46 57.7	66 58 8	9.0 . . .	Dupl., oder neblig.
12	3,168	20 21 30.7	66 38 36	9.1 . . .	Dupl.?
13	3,744	23 5 59.5	65 13 55	9.0 . . . 9.3	9.3 p 1″.3 A 1″.5.
14	3,850	23 38 0.7	68 22 10	8.0 . . . 9.5	130°: 14″.
15	3,861	23 41 10.0	68 21 22	9.3 . . . 9.6	110°: 15″.

The results of my examination are given in the following table. All of the measures were made with the 12-inch refractor:

MEASURES.

No.	1890 +	P.	D.	Magnitudes.	Notes.
1	1.815	215.°9	18."13	9.2 .. 9.2	
	1.838	214.5	17.56	9.0 .. 9.0	
2	1.815	71.7	6.43	9.3 .. 9.4	
	1.838	70.9	6.72	9.0 .. 9.1	
3	1.838	...	...	..	This star is not double. The 9-m star sp., D.M. (66°), 278 (= No. 612) is a nearly equal pair, 212°.2 : 3".0.
4	1.838	242.9	8.01	9.3 .. 9.3	A closer pair near this was found with the 12-inch (= β 1231).
	1.840	242.9	7.97	9.5 .. 9.7	
5	1.838	121.6	26.99	9.0 .. 10.0	
	1.840	121.3	26.46	9.3 .. 9.8	
6	2.397	...	...	..	Not double.
7	2.397	105.1	2.06	10.0 .. 10.3	
8	1.625	...	...	..	Not double.
9	1.622	158.6	5.58	9.3 .. 9.7	
	1.625	158.1	5.71	9.4 .. 9.8	
10	1.622	...	...	..	No comp. of any kind. Other stars near are single.
11	1.622	...	...	..	Single.
12	1.622	...	...	..	Certainly not double.
13	1.622	265.2	14.86	9.0 .. 9.1	
	1.625	265.9	15.19	9.0 .. 9.2	
14	1.622	123.0	17.20	8.7 .. 9.0	
	1.625	123.2	17.33	8.5 .. 9.0	
15	1.622	105.8	14.17	9.3 .. 9.5	
	1.625	105.8	14.44	9.5 .. 9.6	

NEW NEBULÆ.

NEW NEBULÆ.

In the course of my double star work a faint nebula is occasionally found, usually in the field with some bright star under examination. These are almost invariably new, or wanting in DREYER'S General Catalogue, and when near enough to a prominent star to be measured directly with the micrometer, I have saved them as far as it could be done without interfering with the regular work. With the high powers and small fields of the eye-pieces used in observing double stars, a nebula would rarely be seen except when near a star. The lowest power used has a field of only 5′, much too small for very faint, diffused objects. The following nebulæ have been measured with the 36-inch. The places given are those of the stars (1880) from which the nebulæ are measured, the star in each instance being the primary. A few other nebulæ have been found during the examination of special objects from DREYER'S General Catalogue. These are included in "Observations of nebulæ with the 36-inch refractor."

ρ Piscium and nebula.

R. A. $1^h\ 19^m\ 47^s$
Decl. $+\ 18^\circ\ 33'$

1890.564	62.°7	158.″12	...	36
.610	62.6	160.36	...	36
.633	...	159.38	...	36
1890.60	62.6	159.29	...	

94 Piscium and nebula.

R. A. $1^h\ 20^m\ 13^s$
Decl. $+\ 18^\circ\ 37'$

1890.564	117.°4	211.″63	...	36
.610	118.3	211.70	...	36
1890.59	117.8	211.66	...	

A little brighter than the preceding.

Star and nebula.

R. A. $2^h\ 53^m\ 48^s$
Decl. $+\ 37^\circ\ 17'\ 52''$

1890.698	114.°6	95.″33	9.5 ...	36
.709	114.8	95.48	10.0 ...	36
1890.70	114.7	95.40	9.7 ...	

The comparison star is not in the D.M. The place given was determined by Mr. BARNARD with the micrometer from W_2 2^h 1203. There is a faint star about 12″ from the nebula in the direction of 248°.

Star and nebulæ.

R. A. $3^h\ 7^m\ 26^s$
Decl. $+\ 37^\circ\ 25'\ 18''$

South.

1890.698	221.°5	49.″16	..	36
.709	220.0	49.64	11.5 ..	36
1890.70	220.7	49.40	11.5 ..	

North.

1890.698	304.°2	76.″29	..	36
.709	303.6	76.06	..	36
1890.70	303.9	76.17	..	

Both nebulæ are measured from the same star. Its place, as given above, was obtained by Mr. BARNARD from BB. VI + 37°.753, which is $3^m\ 21^s.7$ f, and 4′ 24″.5 n.

D.M. (2°) 684 and nebula.

R. A. $4^h\ 12^m\ 48^s$
Decl. $+\ 2°\ 48'$

1890.709	224.8	210.39	9.5 . .	36
.760	224.9	211.22	9.5 . .	36
.785	224.4	209.73	. .	36
1890.75	224.7	210.45	. .	

Very faint.

Dreyer 1550 and nebula.

R. A. $4^h\ 13^m\ 23^s$
Decl. $+\ 2°\ 7'$

1890.760	163.5	187.88	. . .	36
.785	162.9	189.43	. . .	36
1890.77	163.2	188.66	. . .	

This is in the field with one of D'ARREST's nebulæ, with which the new one is compared. That found by D'ARREST is at least six or eight times brighter than the other. There is a faint star, about 13^m, between the two.

L. 29710 and nebula.

R. A. $16^h\ 11^m\ 29^s$
Decl. $+\ 36°\ 52'$

1890.383	200.3	105.55	. . .	36
.395	200.1	104.95	. . .	36
.422	200.1	104.79	. . .	36
1890.40	200.1	105.10	. . .	

The star is seventh magnitude.

ω Piscium and nebula.

R. A. $23^h\ 53^m\ 9^s$
Decl. $+\ 6°\ 12'$

1889.630	278.6	164.51	. . .	36
.633	278.0	164.09	. . .	36
1889.63	278.3	164.30	. . .	

L. 39690 and nebula.

R. A. $20^h\ 29^m\ 37^s$
Decl. $-\ 0°\ 25'$

1889.633	257.1	84.50	. . .	36
.668	256.9	84.20	. . .	36
1889.65	257.0	84.35	. . .	

The last two are faint objects with the large telescope.

MEASURES OF PLANETARY NEBULÆ.

MEASURES OF PLANETARY NEBULÆ WITH THE 36-INCH EQUATORIAL OF THE LICK OBSERVATORY.

By S. W. Burnham.

During the progress of my regular double star work with the 36-inch equatorial, I have occasionally examined some of the more interesting nebulæ, and incidentally a few of the Herschel planetary nebulæ. It occurred to me that objects of the latter class would be specially suitable for careful micrometrical measures for the purpose of determining, now or hereafter, whether they have any proper motion in space. I assumed that some of the many observers of nebulæ had already done this for at least the brighter nebulæ of this class, or those where the central stars were bright enough to bring them within the reach of ordinary instruments. I was surprised to find, upon looking over many of the works of the leading observers, that very little, almost nothing, had been done in this field; and I determined, therefore, to measure all the objects of this class when it could be done without seriously interfering with the regular micrometer work on double stars. In the selection of objects classed as planetary nebulæ, I have relied, of course, upon Dreyer's General Catalogue. After an examination of a few of the prominent examples, it is not difficult to say whether or not a doubtful object belongs to the planetary class, since it is entirely a matter of appearance in the telescope, and has nothing to do with the nature of the nebulæ as shown by the spectroscope or otherwise. A central star is usually found in these nebulæ. This is so generally the case as to suggest that as the criterion for classification. Some of these stars are very faint, and can only be seen with a large aperture, and, in a few instances, the large object-glass furnishes none too much light for their accurate measurement with the micrometer. As will be seen from the observations, I have found but two or three nebulæ, which could be otherwise described as of the planetary class, where the central star is wanting. From the wide range of these stars in magnitude, it is fair to infer that the missing stars might be seen with a telescope of still greater light-power. One of these is very far south, and too low in this latitude for any very faint star to be seen.

I have also examined Nos. 934, 2440, 2452, 4107, 5144, and 6210 of Dreyer's General Catalogue, and found them more or less lacking in the characteristics of planetary nebulæ. They belong to a much larger and less interesting class of

objects, which would be briefly described as small circular patches of nebulosity. Many of the more recently discovered nebulæ, though very much fainter, and usually smaller, are similar in a general way. I have also looked at a number of the so-called "stellar" nebulæ, discovered by PICKERING, SWIFT, and others. These are all, so far as I have examined them, very small, bright, round nebulæ, which in a small instrument would resemble stars slightly out of focus, but do not appear to come within the planetary class.

Various powers have been used in studying these central stars, and particularly the brighter ones. In no instance has any one of these stars presented under any power any peculiar appearance. So far as it can be determined in this way, they all appear to be true stars, differing in no sense from the comparison stars. Many of the nights on which these measures were made were of the best quality, and any nebulous or other unusual appearance should have been apparent if it really exists.

I have not attempted to give any detailed description of these objects, in the first place because it was foreign to the special purpose in view, and secondly, because verbal descriptions, like most of the drawings, have, at this time, little scientific value, and particularly so far as the question of change or motion is concerned. Certainly no one would predicate any change upon evidence of this kind. Skilled observers, even with instruments of about the same power, differ greatly, and it is impossible to eliminate the real from the imaginary. I have therefore limited my observations to actual measures with the micrometer, the accuracy of which can be tested at any time.

I think there can be no doubt that these central stars are in some way associated with the nebulæ themselves, and that any change in the positions of these stars will be accompanied by a corresponding drift in space of the nebulæ. Of the thousands of nebulæ now known, these examples in the planetary class, with a few exceptions, possibly among very minute nebulæ, are the only ones where any proper motion could be detected within any reasonable time. For this reason there is no reliable evidence yet of the change in position of any nebula in the heavens. There is no apparent reason why the nebulæ should not be distributed in space in the same manner as the stars, and with the same varying distances from our system. If this is so, the nebulæ should be drifting in space with proper motions analogous to those of the stars. A re-measurement of these objects a few years from now will detect at once even a small annual variation. Some of them can be measured with much smaller instruments than the one now used. In some instances the comparison star is very faint, but I have endeavored to select the best star, taking the magnitude and distance both into account. Should any relative change be shown hereafter, it will be easy to determine to which of the stars it belongs.

In the observations which follow, I have used DREYER'S number and place. In nearly every instance the measures were made with a power of 350, the higher

eye-pieces having too small a field for many of the distances. The measures are made by double distances, except in the single instance noted, and, of course, with a bright-wire illumination, which interferes in no way with the visibility of the faintest object.

Barnard.

R. A. $3^h\ 38^m\ 34^s$
Decl. $+\ 34^\circ\ 37'.6$

This planetary nebula was discovered by BARNARD in December last while observing ZONA'S Comet (*Ast. Nach.*, 3017). It is a fine object in the telescope, and perfectly planetary in general appearance. On one occasion I suspected a central star, or a very small nucleus, but this has not been verified. It is slightly elliptical in a north and south direction. A rough setting of the wires on two nights gave, with a power of 1000, 10".0 as the diameter of the nebula in this direction. BARNARD remeasured the diameter December 10, 1890, and obtained 8".5.

The nearest catalogue star is D.M. + 34°, 732, called 9.0-m by ARGELANDER:

Nebula and D.M. + 34°, 732.

1891.689	119°.6	204".50	8.0
.692	119.5	203.74	8.3
1891.69	119.5	204.12	

These are single distances. The measures give for the difference in R. A. 14s.4, and for the difference in Decl. 100".7. In December, 1890, BARNARD observed these differences directly, using the 12-inch refractor, and obtained 14s.4 and 102".0 for the corresponding values.

I have also measured the nearest of the two faint stars referred to in *Ast. Nach.*, 3017, from the center of the nebula, with the following result:

Nebula and 13-m star preceding.

1891.689	288°.4	21".79	13.0
.692	287.8	21.78	13.0
1891.69	288.1	21.78	13.0

The other star 14-m, is 33" from the nebula, in the direction of 347°. The magnitude of the nebula was estimated by BARNARD as 10-m. It is easily found from the sketch of the field given in *Ast. Nach.*, 3017.

Applying the differences obtained above to the D.M. place of the comparison star, we have for the nebula (1860) the place given above.

No. 1501.

R. A. $3^h\ 54^m\ 59^s$
Decl. $+\ 60^\circ\ 32'$

1890.775	193°.8	90".97	12.5 . . 12.7
.777	193.8	91.03	13.5 . . 13.7
1890.77	193.8	91.00	13.0 . . 13.2

This is one of the HERSCHEL planetary nebulæ. The central star is brighter than the nearest available comparison star.

There are two observations of these stars with the ROSSE reflector, the second of which is probably by COPELAND.

1867.961	195°.7	91".5
1873.870	192.9	89.9

No. 1514.

R. A. $4^h\ 0^m\ 30^s$
Decl. $+\ 30^\circ\ 24'$

1891.657	357°.4	69".94	8.6 . . 14.0
.689	357.9	70.11	8.6 . . 14.0
.692	357.2	70.18	8.6 . . 14.0
1891.68	357.5	70.08	8.6 . . 14.0

The small star used for comparison is in, or near, the edge of the nebula. The diameter of the nebula is about 126". The small star does not appear to have been noticed before. HERSCHEL speaks of a "faint star following," and in another observation, "star suspected n. p," but no distance is given. In the drawing by ROSSE (*Phil. Trans.*, 1861), a small star is shown in the direction of 60° or 70°, and distant about one diameter of the nebula from its edge. This nebula is not described as planetary in DREYER. Mr. BARNARD called my attention to it as probably belonging to the planetary class; and it certainly possesses the general characteristics. The surface, however, is not uniform, but broken and mottled.

No. 1535.

R. A. $4^h\ 7^m\ 44^s$
Decl. $-13^\circ\ 6'$

	°	″	
1890.760	257.3	119.42	11.5 . . 12.0
.775	257.0	120.21	11.0 . . 11.5
.785	257.1	119.69	11.0 . . 12.0
1890.77	257.1	119.77	11.2 . . 11.8

Besides the central star, there are other fainter stars within the nebula. The most prominent of these is near the northern edge of the circular disc. I have measured this from the central star as follows.

	°	″	
1890.760	323.1	16.47	15.0
.775	324.6	16.26	14.5
.785	324.7	15.79	14.0
1890.77	324.1	16.17	14.5

This nebula is *H* IV. 26. It has been drawn by D'ARREST (*Instrumentum Magnum Æquatoreum*, 1861); and by LASSELL (*Memoirs R. A. S.*, vols. xxiii. and xxxvi.). The 14.5-m star does not seem to have been seen by these observers.

There are two measures of the distant star by COPELAND at Parsonstown:

	°	″	
1873.003	256.7	122.9	14-m
1873.041	256.7	121.2	13-m

No. 2022.

R. A. $5^h\ 34^m\ 26^s$
Decl. $+9^\circ\ 1'$

	°	″	
1890.802	192.6	95.60	14.5 . . 13.5
.840	192.2	95.34	15.0 . . 14.0
1890.82	192.4	95.47	14.7 . . 13.7

There is no star in the middle of this nebula, but there is a very faint one on the s. p. edge, and that is the one measured. The nearest outside star is n. f., and about one diameter of the nebula distant. With reference to the nebulous disc LASSELL says: "Some bright patches or nodules seem to exist in it, but nothing more can be made out." There are drawings by D'ARREST and LASSELL in the volumes last cited, and also by SECCHI (*Mem. Coll. Rom.*, 1852–5).

No. 2392.

R. A. $7^h\ 20^m\ 53^s$
Decl. $+21^\circ\ 12'$

	°	″	
1890.879	3.0	99.62	9.0 . . . 8.2
.882	2.9	99.74	8.7 . . . 8.2
1890.88	3.0	99.68	8.9 . . . 8.2

One of the most beautiful objects of the kind in the heavens. The central star is round and sharp with all powers. A measure of the diameter of the bright inner disc in the direction of the outside comparison star gave 19″.0; and for the diameter of the whole disc in the same direction 44″.7 (1890.88). There are drawings of this nebula by LASSELL (*Mems. R. A. S.*, xxiii. and xxxvi.); D'ARREST (*Observations of Nebulæ*, 1867); ROSSE (*Phil. Trans.*, 1850); and SECCHI (*Mem. Coll. Rom.*, 1852–55). LASSELL speaks of the comparison star as being nebulous. I did not notice any peculiarity in the appearance of this star. SCHÖNFELD (in 1862.19) made the difference in R. A. $0^s.20$ and in Decl. 100″.4. These stars have been measured directly as follows:

	°	″		
1853.20	2.6	100.12	*OΣ*	4 n
1864.98	2.4	100.16	Knott	4 n
1873.70	2.9	98.00	Copeland	3 n

It is evident no change has taken place in the last forty years.

No. 2438.

R. A. $7^h\ 35^m\ 26^s$
Decl. $-14^\circ\ 25'$

Central Star and Star s. f.

	°	″		
1890.939	127.1	49.88	12.0 . . 11.5	
1891.151	127.6	49.56	12.0 . . 10.7	
1891.04	127.3	49.72	12.0 . . 11.1	

These stars were measured at Parsonstown:

	°	″			
1873.006	128.6	48.7	. . .	Copeland	1 n
1876.123	129.6	50.0	16.0	Dreyer	1 n

Central Star and Star in Nebula.

	°	″	
1890.939	209.0	15.10	14.5
1891.151	210.7	15.27	13.5
1891.04	209.8	15.18	14.0

The last measures connect the central star with a faint star in the s. p. side of the ring. This is probably the star shown in ROSSE's drawing, and

must be the one shown in LASSELL'S drawing, although the position-angle is erroneous if the drawing is to be looked at in the usual way. The outside diameter of the nebula is 63".9. There are drawings by ROSSE (*Phil. Trans.*, 1850); LASSELL (*Mems. R. A. S.*, xxiii.); and SECCHI (*Mem. Coll. Rom.*, 1852–5). COPELAND has a single measure of the last-named star:

1873.063	210°.8	17".4	13–14 . . 16.0

No. 2452.

R. A. $7^h\ 41^m\ 47^s$
Decl. $-27°\ 0'$

Not planetary. There are two nuclei, giving it a sort of dumb-bell appearance.

No. 3242.

R. A. $10^h\ 18^m\ 2^s$
Decl. $-17°\ 56'$

1891.241	173°.1	155".11	12.0 . . 10.5
.244	173.0	155.47	11.0 . . 10.5
.246	173.2	155.98	11.0 . . 10.5
1891.24	173.1	155.52	11.3 . . 10.5

I have made the following measures of this interesting object:

Direction of the longer axis of the ellipse . .	324°.8
Longer diameter of the whole ellipse	42".4
Shorter diameter of the whole ellipse	38 .3
Longer diameter of inside ring	23 .2
Shorter diameter of inside ring	17 .0

This nebula has been drawn by HERSCHEL (*Cape Observations*); LASSELL (*Mems. R. A. S.*, xxiii. and xxxvi.); SECCHI (*Mem. Coll. Rom.*, 1852–5); and ROSSE (*Trans. R. Dublin Soc.*, II.). There is a single observation of these stars by SEARLE (*Annals Harvard Obs.*, xiii.) giving 172°.5 : 154".64 (1868.06). The comparison star is called 13-m. There is also a single measure of COPELAND, 173°.9 : 155".2 (1874.18).

No. 3587.

R. A. $11^h\ 6^m\ 40^s$
Decl. $+55°\ 47'$

1891.239	25°.3	156".15	13.5 . . 10.0
.241	24.5	156.49	14.5 . . 10.5
.244	24.6	156.79	14.5 . . 11.0
1891.24	24.8	156.48	14.2 . . 10.5

This has been drawn by ROSSE (*Phil. Trans.*, 1833, 1850).

No. 4107.

R. A. $11^h\ 59^m\ 35^s$
Decl. $+11°\ 23'$

Not planetary, but it is brighter in the middle, and extended in the direction of 115°. In DREYER it is described as having a star 10–11-m south following. There is nothing in that place, but there is a star of that magnitude north preceding.

No. 6369.

R. A. $17^h\ 20^m\ 49^s$
Decl. $-23°\ 38'$

1891.594	58°.8	90".52	14.0 . . 13.5
.597	56.7	90.30	15.0 . . 13.8
1891.59	57.7	90.41	14.5 . . 13.7

This is an annular nebula, and very much like the well-known example in *Lyra*, except in brightness. The longer axis is in the direction of 33°, and the extreme diameter on that line is 31". HERSCHEL has a drawing in Cape Observations. I am not aware of the central star having been seen before.

No. 6543.

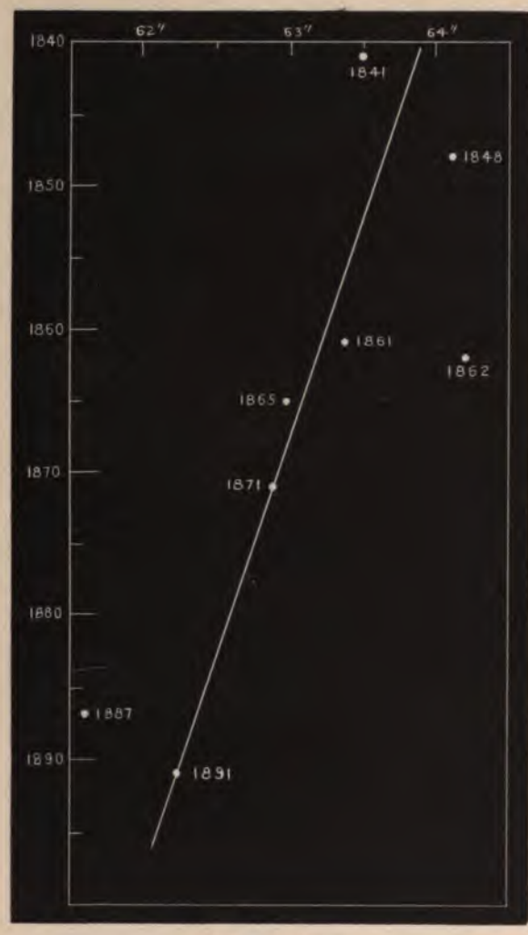
R. A. $17^h\ 58^m\ 36^s$
Decl. $+66°\ 38''$

1891.392	292°.3	163".34	. . .
.395	292.4	163.14	9.5 . . . 9.0
.397	292.4	163.18	9.7 . . . 8.8
.416	292.4	163.28	9.5 . . . 8.7
1891.40	292.4	163.24	9.6 . . . 8.8

This is the well-known planetary nebula in *Draco*. It has been more frequently observed than any other object of this class, with the exception of the ring nebula in *Lyra*. The comparison star is D. M. + 66°, 1065. The only direct measures of these stars which I have found are two single observations with the ROSSE reflector by DREYER, as follows:

1873.709	290°.1	161".6
1873.711	291.2	162.8

In 1871–2 BRUNNOW used the same stars in an attempt to measure the parallax of the nebula, but measured the difference of declination only (*Dunsink Observations*, III.). From a large number of measures he found this difference to



DREYER 6543.

Observed Differences of Declination.

be 62″.90. Later, BREDICHIN, in a similar work, used the same stars and method of observation (*Annals Obs. Moscow*, III.), but I have not seen this volume, and do not know what result he obtained. SCHÖNFELD (1861.64) obtained 63″.4; and SCHULTZ in 1865, as a mean of five rather discordant measures, 63″.0. These different results apparently indicate a movement on the part of one or the other of the stars, or that at least some of the observations are of very doubtful value; but the important fact must be considered that the central star was not really seen at all by most of the observers, and that the measures were made from the estimated center of the nebula. SCHULTZ used the "geometrical center" of the nebula, and SCHÖNFELD evidently did not see the star. At Parsonstown, where the direct measures were made, it was noted "no certain indication of a central star"; and, therefore, these observations, like those giving the difference in declination, cannot be compared with the late measures for the purpose of determining whether or not there has been any relative change. The DUNSINK measures, however, seem to be on different footing in this respect, for BRUNNOW says that the nebula "has in the center a well-defined point resembling a star of the eleventh magnitude. I have compared this point in declination with a star to the north of the tenth magnitude," etc. Evidently the star was not very conspicuous with the DUNSINK equatorial, or it would not have been referred to as a "point resembling a star," but it was undoubtedly well enough seen to make a definite point for placing the wires.

O. STRUVE from a single night found 293°.0; 164″.40 (1848.73), and by two measures of the difference in declination in 1841 and 1848, 63″.5 and 64″.1.

The difference of the declination of the two stars, computed from my measures of the position-angle and distance, is 62″.20. This is 0″.7 less than BRUNNOW's value, and should be much too large for the ordinary errors of observation, particularly in measures of this kind, where the telescope is stationary, and the bisection of the stars is so easily and certainly made. After learning of this difference I determined to see whether the value derived from the angle and distance would be confirmed by observing the difference of declination with the same instrument used in the direct measures. By this method I obtained the following:

1891.652	Dif. Decl. = 62″.42
.655	62.31
.666	62.25
.671	62.34
1891.66	62.33

The difference between this result and that derived from the first series of measures is only 0″.13, a quantity which is insensible in direct measures of that distance, and within the limits of error in careful observations.

The various results found for the difference in

the declination of these two stars, arranged in chronological order, are as follows:

1841	Dif. Decl.	63.″5	$O\Sigma$
1848		64.1	$O\Sigma$
1861		63.4	Schönfeld
1862		64.2	Argelander
1865		63.0	Schultz
1871		62.90	Brunnow
1887		61.6	Engelhardt
1891		62.26	β

All of these measures appear to have been made with the micrometer, with the exception of ARGELANDER's, which were with the meridian circle. (*Bonn Observations*, VI.)

These observations are laid off to scale on the accompanying diagram. It is apparent that there is a slow change in the declination of one of these stars, and that the difference is steadily decreasing. An examination of these positions, and omitting for this purpose those of 1862 and 1887, shows that the annual change in declination amounts to 0.″033. It is probably impossible to determine at this time to which star, if only one, this motion belongs.

There are drawings of this nebula by VOGEL (*Bothkamp Observations*, IV.), and by HOLDEN and SCHAEBERLE (*Mon. Not.*, xlviii., 390).

No. 6563.

R. A. $18^h\ 2^m\ 48^s$
Decl. $-\ 33^\circ\ 53'$

This nebula is fairly planetary in appearance, and there seem to be some faint stars in it, but the central star is wanting. No drawings cited in DREYER.

No. 6572.

R. A. $18^h\ 5^m\ 18^s$
Decl. $+\ 6^\circ\ 50'$

1891.575	77.°0	33.″02	10.5 . . 14.5
.578	75.5	32.82	11.0 . . 15.5
.597	76.6	33.08	11.0 . . 15.0
1891.58	76.4	32.97	10.8 . . 15.0

This is one of the brightest of the planetary nebulæ. It is sometimes spoken of as Σ 6, which is an unfortunate as well as an improper method of referring to the list of nebulæ observed by STRUVE, since the symbol Σ preceding a numeral has been universally used to designate the double stars comprised in the great catalogue of double stars, *Mensuræ Micrometricæ*.

There are drawings of this nebula by SECCHI (*Mem. Coll. Rom.*, 1852–5), and by VOGEL (*Pub. Potsdam Obs.*, IV.). I have not seen these illustrations.

No. 6720.

R. A. $18^h\ 48^m\ 23^s$
Decl. $+\ 32^\circ\ 51'$

1891.326	88.°2	61.″64	15.5 . . 12.0
.416	87.8	61.44	15.5 . . 13.5
.419	86.5	61.56	15.5 . . 12.0
.518	88.4	62.28	15.0 . . 13.0
.559	88.0	61.56	15.5 . . 11.5
1891.45	87.8	61.69	15.4 . . 12.4

This is the well-known annular nebula in *Lyra*. All the measures were made under very favorable conditions, and the central star well seen. When the seeing was the best, and perfect for all practical purposes, the ring and the darker interior were carefully examined with various powers, but without detecting any other stellar point. In various places there are minute areas of slightly brighter nebulosity, but none of them appear to be stars. There are many drawings of this nebula. The comparison star in the foregoing measures is the familiar one near the following edge of the nebula.

No. 6781.

R. A. $19^h\ 11^m\ 38^s$
Decl. $+\ 6^\circ\ 17'$

1891.562	72.°1	49.″22	15.0 . . 12.0
.575	74.5	49.50	15.0 . . 13.0
1891.57	73.3	49.36	15.0 . . 12.5

The primary star is not central, but is north of the middle. Drawings have been made by LAMONT and LASSELL.

No. 6818.

R. A. $19^h\ 36^m\ 4^s$
Decl. $-\ 14^\circ\ 29'$

This seems to present a true planetary appearance, but there is no central star. There appear to be two or three slight condensations of nebulous matter, which at first glance might be taken for faint stars, but I do not think they are real stellar points. There are drawings by ROSSE, LAMONT, D'ARREST, and SECCHI.

No. 6826.

R. A. $19^h\ 41^m\ 2^s$
Decl. $+\ 50^\circ\ 11'.2$

1891.747	194°.1	96".15	9.0 . . 10.0
.750	194.4	96.17	8.7 . . 9.0
1891.75	194.2	96.16	8.8 . . 9.5

This beautiful object is almost an exact duplicate of the planetary nebula in *Draco*. It is slightly elliptical, with the longer axis in the direction of 295°. A setting of the wires gave for the longer diameter 26".6, and for the shorter 24".3. There are a number of stars nearer than the one measured. The nearest, about 14-m, is 27".0 from the central star, in the direction of 283°.1. Drawings have been made by HERSCHEL and SECCHI.

ENGELHARDT (*Observations Astron.*, II.) by three measures made the difference of declination between the two stars, 93".5 (1887.79). Computed from my angle and distance it is 93".2.

No. 6891.

R. A. $20^h\ 8^m\ 32^s$
Decl. $+\ 12^\circ\ 19'$

Central Star and p Star (a).

1890.785	242°.3	42".67	11.0 . . 12.0
.840	242.5	43.20	12.0 . . 13.0
1890.81	242.4	42.93	11.5 . . 12.5

Central Star and p Star (b).

1890.802	289°.0	57".15	12.5 . . 11.5
.840	289.4	57.40	12.0 . . 10.5
1890.82	289.2	57.27	12.2 . . 11.0

In making the second measure a different comparison star was used, and therefore both were subsequently measured. This nebula was discovered by COPELAND.

No. 6894.

R. A. $20^h\ 10^m\ 45^s$
Decl. $+\ 30^\circ\ 8'$

1891.594	186°.7	119".65	15.0 . . 11.5
.610	185.3	119.92	15.0 . . 10.8
1891.60	186.0	119.78	15.0 . . 11.1

Considerably darker in the middle, and apparently belongs to the annular class. The faint star within is not central, but is near the preceding side. There are many stars nearer the nebula than the 11-m comparison star. This nebula has been figured by ROSSE (*Phil. Trans.*, 1833). (*Trans. R. Dublin Soc.*, II.)

No. 6905.

R. A. $20^h\ 16^m\ 9^s$
Decl. $+\ 19^\circ\ 40'$

1891.594	358°.0	46".76	14.0 . . 10.0
.610	357.2	46.61	14.0 . . 10.0
1891.60	357.6	46.68	14.0 . . 10.0

A measure of the diameter of this nebula in the direction of the 10-m star gave 39".1. There are many drawings by the principal observers. SEARLE gives difference of declination between nebula and star (central star not mentioned) as 46".33 (1867.65). (*Annals Harvard Coll. Obs.*, XIII.)

No. 7009.

R. A. $20^h\ 56^m\ 33^s$
Decl. $-\ 11^\circ\ 55'$

1890.709	343°.3	96".45	12.5 . . 13.0
.725	343.7	96.55	11.5 . . 12.0
.777	343.4	96.13	12.0 . . 13.0
1890.74	343.5	96.38	12.0 . . 12.7

There are many drawings of this object, sometimes called the "*Saturn* nebula," references to which will be found in DREYER.

The following single measures are from the ROSSE observations:

1873.655	343°.3	99".0
1874.695	343.3	101.2

No. 7026.

R. A. $21^h\ 1^m\ 33^s$
Decl. $+\ 47^\circ\ 17'$

1891.562	271°.7	6".21
.575	272.6	6.40
.578	274.5	6.74
1891.57	272.9	6.45

This nebula was discovered by me in 1873 with the 6-inch refractor, with which it was also seen double or elongated. One of the nuclei is brighter than the other. The measures given above are of the angle and distance between

these nuclei. They are not stars, but small enough for fairly accurate bisection. This object does not properly belong to the planetary class of nebulæ. Some rough measures were made a few years ago, which differ much from the results given here, but it is not probable that any change has occurred in the nebula.

No. 7027.

R. A. $21^h\ 1^m\ 48^s$
Decl. $+\ 41^\circ\ 40'$

1891.575	131.0
.578	135.1

Discovered by WEBB. It has two nuclei, the following one of which is fairly well defined, but the brighter is too large and diffused for reliable measures of distance. There is nothing planetary about the appearance of this nebula. The nearest star is 15-m, and is about 14″ from the bright condensation, in the direction of 96°.

No. 7208.

R. A. $21^h\ 59^m\ 25^s$
Decl. $-\ 29^\circ\ 44'$

This is a faint circular nebula, but not specially planetary in appearance. HERSCHEL'S description is "almost planetary."

No. 7354.

R. A. $22^h\ 35^m\ 8^s$
Decl. $+\ 60^\circ\ 33'$

There seems to be a faint condensation near the margin of the nebula on the preceding side, but there is no central star; otherwise it presents the true planetary appearance. DREYER has no reference to any drawings.

No. 7662.

R. A. $23^h\ 19^m\ 11^s$
Decl. $+\ 41^\circ\ 46'$

1890.782	62.4	51.82	15.0 . . 13.0
.785	63.4	51.87	15.0 . . 13.0
1890.78	62.9	51.84	15.0 . . 13.0

A number of drawings have been made of this nebula, references to which will be found in DREYER. SEARLE (*Annals Harvard Coll. Obs.*, XIII.) measured the outer star from the center of the nebula (the central star not seen), and from two observations gives 62°.7 : 52″.14 (1866.80). O. STRUVE, from four nights, found 61°.3 : 51″.85 (1847.86). He states that the central star, which has been noted with the ROSSE reflector, was not seen. (*Mélanges Math. et Ast.*, III.)

OBSERVATIONS OF NEBULÆ WITH THE 36-INCH REFRACTOR OF THE LICK OBSERVATORY.

By S. W. Burnham.

The observations of nebulæ which follow were all made with the 36-inch equatorial, and substantially all of them in the months of September and October, 1891. Most of the objects were selected from the General Catalogue, because of some uncertainty in the descriptions of the nebulæ, or doubt concerning their places or actual existence. These observations were dove-tailed in with the regular work, so as not to interfere materially with the more important micrometer measures of close double stars; and, of course, the best nights were not used for this purpose, but the conditions were good enough for work of this character.

I have relied upon Dreyer's General Catalogue for the places and the general descriptions. The numbers used in all cases refer to this work. I have referred the places derived from the measures to 1860, the epoch of the General Catalogue. It would certainly be a great convenience to observers if the places of all newly discovered nebulæ were given in the same way. There is nothing gained by carrying the places forward to any current date. So far as setting on these objects is concerned, one time is as good as another, and since we have a general catalogue there is every reason for adhering to that epoch. For the general purposes of a catalogue approximate places are sufficient, and the nearest minute of R. A. is close enough; but it is very desirable that as many nebulæ as possible should be carefully observed with the micrometer, and measured directly (angle and distance) from some convenient star for the detection of proper motion. It is in this way only that change of this character is likely to be discovered. The R. A. and Decl. may have the highest accuracy, but there is no way of easily ascertaining whether there has been any movement. If we have the angle and distance from a star in the field, the micrometer wires can be placed in a couple of minutes so as to show whether or not it is necessary to do anything more. Of course, for this purpose it is a matter of no consequence that the comparison star is not found in any catalogue.

In the course of these observations some new nebulæ have been found in the vicinity of the catalogue nebulæ under examination. These are referred to in the proper places. No attempt has been made to find new objects, and in my regular

work with micrometer the faint nebulæ which are occasionally met with are, as a rule, only saved when they are near enough to some prominent star for direct measures.

No. 607.

R. A. $1^h\ 27^m\ 16^s$
Decl. $-\ 8^\circ\ 7'.8$

This is one of D'ARREST'S nebulæ, given in DREYER with the note, "11-m star nebulous?" and it is further stated, "No nebulosity seen by SCHÖNFELD, but AUWERS saw it (*Kon. Beob.*, 226)."

This should be, from the catalogue place, a little preceding an 8½-m star. There is certainly nothing in this place. I found a rather conspicuous nebula a short distance following, which was subsequently identified as DREYER 615. This has a bright central nucleus, with long nebulous wisps extending on each side in the direction of 160°—340°. These streaks extend roughly about 33″ on either side of the nucleus. This nebula is 20ˢ following, and 126″ north of the 8½-m star mentioned above. The star is S.D. (8°) 273. Applying these differences to the S.D. place of the star, we have for the place of the nebula (1860):

R. A. $1^h\ 28^m\ 26^s$
Decl. $-\ 8^\circ\ 3'.3$

This agrees substantially with HERSCHEL'S place. A few nights later (1891.753) this region was very carefully examined again. There was nothing in the catalogue place of DREYER 607 in the least suggestive of nebulosity. There is no doubt that No. 615 is the object which has been seen in looking for the other, and that it is one of the many instances of mistaken identity.

No. 618.

R. A. $1^h\ 28^m\ 20^s$
Decl. $+\ 32^\circ\ 40'.6$

DREYER has the note: "Never found at Birr, nor by D'ARREST. SCHÖNFELD has two observations, very faint, excessively small = 13-m star, place agreeing with HERSCHEL. Query: only a faint star."

The catalogue place was carefully examined (1891.747) without finding the least trace of any nebulous object. I found two faint nebulæ a short distance north, and compared them with the 8.2-m star, D.M. (32°) 281. The first is 1ᵐ 21ˢ preceding, and 22″.4 south of that star; and the second is 58ˢ preceding, and 68″.4 north of the same star. These objects are respectively DREYER 608 and 614. The differences applied to the D.M. place of the comparison star give for the nebulæ (1860):

Dr. 608 R. A. $1^h\ 27^m\ 23^s$
Decl. $+\ 32^\circ\ 56'.1$

Dr. 614 R. A. $1^h\ 27^m\ 46^s$
Decl. $+\ 32^\circ\ 57'.6$

The right ascensions are each 7ˢ less than the catalogue places, while the declinations are substantially the same. On a subsequent night this region was carefully gone over, with the same result so far as No. 618 is concerned. There is certainly nothing in the catalogue place, and this object has probably been confounded with one of those mentioned above. This is also the case with No. 627. The place of this is a little following the two measured, and in about the same declination. The place of this was doubtful to HERSCHEL, who says: "The R. A. conjectural, and P.D. liable to some error." It is safe to say that Nos. 618 and 627 do not exist, and that the observations credited to them really belong to Nos. 608 and 614.

No. 707.

R. A. $1^h\ 44^m\ 31^s$
Decl. $-\ 9^\circ\ 12'.0$

This nebula was discovered by TEMPEL, and was described by him "very faint; faint star in center." I looked this up (1891.766) more particularly to see whether it belonged to the planetary class, the possibility of that being suggested by the central star mentioned. It does not belong to that order of nebulæ. There are really two stars, one much fainter than the other, with a faint, diffused nebulous light surrounding them. I called the magnitudes 13.5 and 15.5. The latter would, of course, be entirely beyond the reach of the instrument used by TEMPEL. A rough setting of the wires gave for the angle between these stars 302°, and for the distance between them 10″.4.

The nebula was compared with a small star preceding, S.D. (9°) 345. This is 9.8-m in S.D. The nebula is 45ˢ following, and 26″.8 north.

Applying these differences to the S.D. place of the star, gives for the nebula (1860):

R. A. $1^h\ 44^m\ 31^s$
Decl. $-\ 9^\circ\ 12'.8$

In identifying and fixing the place of this nebula I found a new one in the immediate vicinity, which was measured directly from the same comparison star used for the other.

S.D. (9°) 345, and New Nebula.

1891.766 P = 260°.9 D = 221″.3

These measures give for the place of the new nebula (1860):

R. A. $1^h\ 43^m\ 31^s$
Decl. $-\ 9^\circ\ 13'.4$

This is fainter than the other, though easily enough seen.

No. 736.

R. A. $1^h\ 48^m\ 35^s$
Decl. $+\ 32^\circ\ 21'.1$

There is a cluster of faint nebulæ in this place. The catalogue places of the others are:

No.	R. A.	Decl.	
737	$1^h\ 48^m\ 36^s$	32° 21″.6	Rosse.
738	1 48 38	32 22.0	Rosse.
739	1 48 47	32 28.0	Copeland.
740	1 48 48	32 19.7	Rosse.

No. 737 is described: "Stellar nebula (? faint star) 27″ north of *h* 169 (No. 736)." The 36-inch shows that this is not a nebula, but a faint star, 13.5-m. Two measures of this from *h* 169 were made with the Parsonstown reflector. Evidently they are only very rough settings, as the difference in the distances is much too large for careful measures. These observations and my own are as follows:

	°	″
1850.775	10.4	27.0
1874.022	11.9	35.1
1891.766	9.8	32.31

The 36-inch shows a very faint star, which I have called 15.5 magnitude, between and a little preceding the line joining the two objects measured above (Nos. 736 and 737). A single setting of the wires makes the new star 22″.0 from No. 736, in the direction of 7°.6. Of course a star of this magnitude is a faint object with the largest apertures. There is no trace of any nebulosity about either star. There is no doubt that No. 737 should be rejected as a nebula from any future general catalogue.

The position of No. 738 was also measured from *h* 169 at Parsonstown. This and the later measures are as follows:

No. 736 and No. 738.

	°	″		
1850.775	43.7	75.00	Rosse	1 n
1891.766	47.3	82.34	*β*	1 n

DREYER 740 is not far from a 9.4-m star, and I have measured the angle and distance directly, as was done at Parsonstown:

D.M. (32°) 348 and No. 740.

	°	″		
1874.022	278.2	74.6	Rosse	1 n
1891.766	279.3	74.11	*β*	1 n

My measures applied to the D.M. place of the comparison star give for the place of the nebula (1860):

R. A. $1^h\ 48^m\ 48^s$
Decl. $+\ 32^\circ\ 18'.5$

There are some other faint nebulæ in the vicinity (Nos. 733, 750, 751, 760, and 761), but I did not examine these.

No. 874.

R. A. $2^h\ 9^m\ 43^s$
Decl. $-\ 23^\circ\ 50'.5$

This was discovered by MÜLLER with the 26-inch refractor of the McCORMICK Observatory. The description is: "Excessively faint, pretty small, extended 170° (? double star), 10-m star n. p."

I could not find any nebula in or near this place. The vicinity was carefully swept over, without coming across any nebulous or suspicious object. The assigned place is well marked, as the nebula should be about 9′ south of an 8½-m star (GOULD 2301). This star, by the way, is double (new), 160°: 1″.2: 8.7 . . 10 estimated. It is safe to say that this nebula has no real existence. Probably a faint star was seen. The large telescope shows many near this place.

No. 878 is south following the place of the other. I compared this with a neighboring star (GOULD 2284), which is $2^m\ 19^s.5$ preceding, and 43″.6 south of the nebula. This gives for the nebula (1860):

R. A. $2^h\ 11^m\ 30^s$
Decl. $-\ 24^\circ\ 1'.9$

This was discovered by LEAVENWORTH with the McCORMICK telescope. The R. A. from my observations is 40ˢ greater than that given in the General Catalogue. The declinations are nearly the same. This is a faint globular nebula, and comparatively easy.

No. 905.

R. A. $2^h\ 16^m\ 26^s$
Decl. $-\ 9^\circ\ 22'.2$

This is also one of LEAVENWORTH'S discoveries with the McCORMICK 26-inch. In or very near the place I found what seemed to be an exceedingly faint patch of nebulous light. The seeing was not good enough to be certain that it was not due to faint stars, but it is probably a nebula. This is a very blank region for stars, and as there was no convenient comparison star, the place of the object was not taken.

No. 942.

R. A. $2^h\ 21^m\ 30^s$
Decl. $-\ 11^\circ\ 27'.2$

No. 943 has exactly the same R. A., and is 1′.0 less in Decl., and given with the description, "Very faint, round, neb. double star?" These were discovered by MÜLLER at the McCORMICK Observatory. These objects should be very near a faint S.D.M. star, 9.4-m. The R. A. of that star is but 4ˢ more than that given for the nebulæ, and its Decl. $-\ 11^\circ\ 24'.8$, and therefore the nebulæ should be about 1′ or 2′ south. There are two faint stars nearly in this place, but they have no nebulous appearance, and are certainly nothing but faint stars. A little following this place there is a small faint nebula (*a*), and still farther following a double nebula (*bc*). Both components of the latter have faint nuclei. The brightest of the two is *b;* and *a* is considerably fainter than either. I have compared these with the star mentioned above, S.D. (11°) 466, with the following result:

Neb. (*a*) *s* of star 187″.5 and 26ˢ*f*
Neb. (*b*) *s* of star 201″.6 and 49ˢ*f*

The double nebula was measured directly:

Neb. (*b*) and Neb. (*c*).

1891.769 P = 340°.3 D = 33″.90

These observations give the following places for these nebulæ for 1860:

Neb. (*a*)	$2^h\ 22^m\ 0^s.5$	$-\ 11^\circ\ 27'.9$
Neb. (*b*)	2 22 23.5	− 11 28.1
Neb. (*c*)	2 22 22.7	− 11 27.6

There is but little doubt that the two nebulæ discovered by MÜLLER are *b* and *c* of the foregoing observations. The other, *a*, is fainter, and might have been easily overlooked, and is certainly new.

There is a star $8\frac{1}{2}^m\ 13^s$ following, and 9′.4 north of the comparison star previously referred to, which is a new double star. As the components are quite unequal, it will not be readily seen with most instruments. This star is S.D. (11°) 467 (= WEISSE II. 356 = SANTINI 197). The star catalogues differ some in the declination. My measures of the companion are as follows:

1891.769 250°.9 4″.02 8.2 . . 13.0

Two other nebulæ were found north preceding the double star; subsequently identified as Nos. 945 and 948 of DREYER. The nearest was measured from the double star, and then the two nebulæ with reference to each other, with the following results:

Weisse II. 467 and No. 945.

1891.769 P = 334°.6 D = 277″.5

No. 945 and No. 948.

1891.769 P = 50°.6 D = 152″.4

Using the WEISSE place of the comparison star, these observations give for the nebulæ (1860) the following:

No. 945 R. A. $2^h\ 21^m\ 39^s$
Decl. $-\ 11^\circ\ 11'.7$

No. 948 R. A. $2^h\ 21^m\ 47^s$
Decl. $-\ 11^\circ\ 10'.1$

In the General Catalogue there is a difference of 24ˢ in the right ascensions, and 1′.6 in the declinations. The first was discovered by HERSCHEL I., and the other by SWIFT at the WARNER Observatory.

No. 955.

R. A. $2^h\ 23^m\ 26^s$
Decl. $-\ 1^\circ\ 44'.0$

This nebula, which was discovered by HERSCHEL I., has not been found at times by some observers, and variability has been suggested as

an explanation. DREYER has this note: "In *Monthly Notices*, xxxviii., 104, WINNECKE drew attention to the remarkable circumstance that this nebula was invisible to SCHÖNFELD in December, 1861, and to VOGEL in November, 1865, while it was easily seen by D'ARREST, SCHÖNFELD, and WINNECKE in 1856, 1863, 1864, 1868, and 1867. Possibly the brightness of this object is variable. In November, 1887, it was fully of the second class."

I found this (1891.747) in the proper place without difficulty. It is a long, narrow nebula, in a general way similar to DREYER 607, which was examined a few minutes before. It has a bright central condensation, with nebulous wings on either side in the direction of 15°—195°. A setting of the wires gave for the extreme length, 75″. On the whole it is rather a curious object, and should be easily found and seen. It is probable that the failures to find it, mentioned above, were due to unfavorable atmospheric conditions. This would fully explain the observations with the moderate apertures which were probably used.

No. 988.

R. A. $2^h\ 28^m\ 34^s$
Decl. $-\ 9^\circ\ 57'.9$

This was discovered by STONE at the McCORMICK Observatory, and is described in DREYER as a "nebulous star 7.5-m." I could see (1891.766) nothing suggestive of any nebulosity about this star, or any peculiarity in its appearance. Other stars of about the same magnitude in the vicinity were looked at, and I could not detect any appearance in the star in question which was not common to the others. It was examined on the same occasion by BARNARD, and he came to the same conclusion. It is therefore safe to say that the suspected nebulosity about this star is a mistake.

No. 1059.

R. A. $2^h\ 34^m\ 45^s$
Decl. $+\ 17^\circ\ 24'.5$

This is one of HERSCHEL'S nebulæ, "excessively faint, hardly sure." DREYER says, "Not found by D'ARREST on a very clear night." I examined this region very carefully, and am satisfied that there is nothing in the catalogue place. About 1^m preceding this place, and 12′ south I found a very faint nebula. This would be estimated as perhaps 14 magnitude. It is about 30″ or 40″ in diameter, with a gradual brightening toward the middle. It is impossible to say with certainty whether this is the HERSCHEL object, but it is improbable from the description. It is not otherwise in the General Catalogue.

This was compared with a 7.8-m star, D.M. (17°) 419 (= WEISSE II. 820). This nebula is 183″.9 north of this star, and 37ˢ preceding, giving for its place (1860):

R. A. $2^h\ 33^m\ 37^s$
Decl. $+\ 17^\circ\ 12'.7$

There is a small star near the catalogue place of HERSCHEL'S nebula, D.M. (17°) 422, which is a new double star. I did not measure it, but estimated, 160° : 1″ : 9.5 . . 10.5.

No. 1186.

R. A. $2^h\ 56^m\ 20^s$
Decl. $+\ 42^\circ\ 16'.5$

This was discovered by the first HERSCHEL (= II. 502 = *h* 281). DREYER has the following note: "'Twice looked for by Lord ROSSE, but not found; often searched for in vain by D'ARREST. H. calls it 'a pretty bright star with two faint branches;' he has 'a star 14-m, with some kind of nebulous appendage.'"

This was readily found (1891.747) in the proper place. It is a 10-m star involved in a faint, elongated nebula. The conditions at this time were not very good, but the nebula appeared to be at least 2′ or 3′ in the longest direction. It precedes an 8.8-m star, D.M. (42°) 697, by 44ˢ, and is 274″ south. From the D.M. place of the star we have for the nebula (1860):

R. A. $2^h\ 56^m\ 18^s$
Decl. $+\ 42^\circ\ 17'.7$

No. 1363.

R. A. $3^h\ 28^m\ 6^s$
Decl. $-\ 10^\circ\ 18'.8$

This nebula was found by me with the 18½-inch at Chicago in 1877. A companion nebula, No. 1364, was discovered subsequently by MÜLLER with the McCORMICK 26-inch. The first was measured by me at the time of discovery from the 6½-m star, L. 6634. The difference between the two distances is doubtless due to the fact that this is a large and generally round mass of diffused nebulosity without any central brightness for the

accurate placing of the wires. The nebula, as a whole, is bright enough to be easily seen with the large star in the field. The measures are as follows:

L. 6634 and No. 1363.

1877.997	P = 62°.1	D = 206″.7
1891.845	60.8	203.4

No. 1363 and No. 1364.

1891.845	P = 84°.0	D = 136″.5

Swift ix. 13.

In *Monthly Notices* for December, 1891, DREYER has called attention to a nebula discovered by SWIFT (*Ast. Nach.*, 3004) since the publication of the General Catalogue which may possibly be variable when all the observations, negative and positive, are considered. SWIFT was unable to find it again, and suggested that it might prove to be a comet. HERSCHEL II. had recorded an object in this place, but it was rejected in his General Catalogue as being identical with a nebula a short distance preceding, discovered by HERSCHEL I. It appears also to have been seen with the ROSSE reflector at times, and invisible at other times. For details concerning these observations reference is made to the paper in *Monthly Notices* previously referred to.

I examined (January 28th) the several nebulæ in this region, No. 1397 (= III. 569), No. 1417 (= II. 455 = *h* 306), No. 1418 (= II. 456 = *h* 307), and No. 1424 (ROSSE), with the following result:

All of these objects were readily found as given in DREYER'S Catalogue. SWIFT'S nebula is in the place given by him, in line with Nos. 1417 and 1418. It is much fainter than No. 1418, the faintest of the HERSCHEL nebulæ mentioned above, and has but half or two thirds of the light of No. 1424. I compared it with the 8-m star north following (LALANDE 6870). The nebula is 72ˢ preceding that star, and 223″ south. We have for the place of this object (1860) the following:

h 305	3ʰ 34ᵐ	32ˢ.5	−5°	7′ ±
Swift	3 34	37 .0	−5	8.0
Burnham	3 34	34 .0	−5	7.0

It follows, therefore, that SWIFT'S nebula is really identical with the rejected *h* 305.

There is no catalogue star near enough for direct measurement. There is a 12-m star nearly following, which I have measured from the nebula as follows:

Neb. and star P = 92°.8 D = 155″.0

There is a fainter star much nearer the nebula in the direction of about 300°, and distant, perhaps, 20″ or 30″.

With reference to the question of change, it can only be said that the evidence of change does not appear to be entitled to much weight, and the probabilities are that this object has been missed simply because the atmospheric conditions were not sufficiently favorable. The observer is much more liable to overlook differences of this kind when using the low powers ordinarily employed in work of this character. With powers of 400 or 500 and upwards used in making double-star measures, the difference in regard to illumination and definition on different nights is very apparent, and it is only on the very best nights that negative results have any value or significance. In double-star work it is almost a nightly occurrence with any telescope, large or small, that the instrument is pointed to stars which cannot be seen double on that occasion. In my experience this has happened thousands of times, but I have yet to find the first double star where these failures even suggested any variation in the light of either component. It would be very interesting to find a variable nebula, and this object should certainly be watched for awhile to see whether there is any change in its light. DREYER has pointed out that while this nebula was not seen on various occasions, it was only specially looked for in 1877 and 1890. It is easy to see how it might be overlooked under certain conditions, even with a pretty large instrument. In this connection I should say that the night on which my observations were made was much too poor to do any kind of double-star work, even on the easiest pair, and therefore this nebula would appear fainter than it really is, but this would not affect the comparison with the other nebulæ in the vicinity.

Barnard's New Merope Nebula.

R. A. 3ʰ 37ᵐ 52ˢ
Decl. + 23° 20′

In November, 1890, BARNARD discovered a new nebula in the Pleiades (*Ast. Nach.*, 3018) which had escaped detection by all previous observers

from the fact that it is so close to the bright star, *Merope*, that it is buried in the brilliant light of that star, and completely hidden in ordinary observations. I have lately made a set of measures of this singular object from *Merope* with the 36-inch equatorial. The nebula is readily seen with that instrument when one is aware of its existence, and it can probably be seen now with a somewhat smaller aperture; at the same time, its discovery with any instrument is little less than remarkable, from the difficulty of seeing it at all except when the bright star is placed outside of the field, and, of course, there is only one position which is favorable for this purpose. The distance between the two is so small, that the nebula even then is in the extreme margin of the field, and easily overlooked without careful attention.

Merope and New Nebula.

1891.689	167°.1	37″.72
.692	167.0	35.79
.728	164.2	36.00
.731	167.0	34.89

BARNARD, with the same instrument, measured the difference of right ascension and declination between the two objects, and obtained:

Diff. R. A. = 9″.04
Diff. Decl. = 35 .72

The position-angle and distance deduced from these observations, and the mean result of the foregoing direct measures, are as follows:

1890.92	165°.8	36″.85	B	2 n
1891.71	166.3	36.10	β	4 n

These independent results are certainly remarkably accordant, when the character of the new nebula is considered. If it were a star, or had a well-defined central point, there would be no difficulty; but in this case a faint disc of light, at least 10″ or 12″ in diameter, has to be bisected by the wire in the extreme margin of the field, and there is necessarily under the circumstances a good deal of uncertainty in doing this, as compared with the bisection of a star, however faint or difficult to see.

A rough setting of the wires to include the more readily visible diameter of the nebula in the direction of *Merope* gave 12″.8; but this must not be taken as a measure, even approximately, of its extreme dimensions. In the paper referred to BARNARD estimated it as about 30″ in diameter, and I have no reason for changing this value. The drawing given in *Ast. Nach.*, 3018, is a faithful representation of the nebula and its position with reference to *Merope*.

This is not only far more interesting than any of the nebulæ heretofore discovered in the Pleiades by visual and photographic methods, but, judging from its situation and appearance, is one of the most singular objects in the heavens. With respect to its nearness to a bright naked-eye star it is unique. There may be other examples, but certainly no other has ever been discovered, and this close association of a faint nebula and one of the prominent stars of the Pleiades is an interesting fact whether such association is accidental or otherwise. No star bright enough to be visible to the naked eye is known to have a small, definite nebula even within several times the distance of this nebula from *Merope*. Of course there are many examples of large stars involved in widely diffused and extended nebulous masses, of which TEMPEL'S nebula about the star in question is an illustration, but these nebulous objects appear to be of an entirely different character from the circular, condensed forms so often found among the small detached nebulæ. It may be that a careful examination of the bright stars by cutting off their light from the surrounding field would reveal other examples of companion nebulæ.

These measures were made with a power of about 500, in order to give the best separation and get rid of the objectionable light of the star as far as possible. Of course, with such a power nothing would be seen of the nebulous background discovered by TEMPEL. These measures may be of more interest in the future when it will be possible by careful remeasurement to ascertain whether the new nebula is drifting in space with *Merope* and the other stars of this famous group.

Barnard.

R. A. $3^h\ 38^m\ 34^s$
Decl. $+\ 34^\circ\ 37'.6$

This planetary nebula was discovered by BARNARD with the 36-inch telescope of the LICK Observatory, in December, 1890, while examining the region near ZONA'S Comet (*Ast. Nach.*, 3317). I have examined this on three different nights with the same instrument. It is a beautiful object, and has all the characteristics of the

regular planetary nebulæ, with the single exception of the central star. On one occasion I suspected the existence of a faint star or nucleus, but could not be certain of it at that time or later. There are two small stars near it, as referred to in *Ast. Nach.*, 3017. The nearest I have measured from the nebula, and have also compared the latter with the 9-m star, D. M. (34°) 732.

Nebula and Companion Star.

1891.689	P = 288°.4	D = 21″.79 . . 13-m
.692	287.8	21.78 . . 13-m
1891.69	288.1	21.78 . . 13-m

The other star, which is fainter, 14.5-m, is 33″ from the nebula in the direction of 347°.

Nebula and D.M. (34°) 732.

1891.689	P = 119°.6	D = 204″.5
.692	119.5	203.7
1891.69	119.5	204.1

The same comparison star was used by BARNARD, who measured the difference of R. A. and Decl. directly. Reducing my angle and distance to the same terms, the results are:

	Diff. R. A.	Diff. Decl.		
1890.94	14ˢ.4	102″.0	B	1 n
1891.69	14ˢ.4	100″.7	β	2 n

The nebula is slightly elliptical in a north and south direction. Measures of the diameter in the direction of 180°, using a power of 1,000, gave the following:

1891.671	10″.9
.689	9″.1
1891.68	10″.0

The place of this nebula for 1860, given above, is derived from the D.M. place of the comparison star, and the measured differences.

No. 1458.

R. A. $3^h\ 40^m\ 40^s$
Decl. $-\ 18°\ 40'.7$

This is from the catalogue of nebulæ discovered by LEAVENWORTH at the MCCORMICK Observatory. The description in DREYER is, "Very faint; very small; round; planetary? nebula?" This region was carefully swept over, and the only thing found was a bright, globular nebula about 2^m preceding the place given for No. 1458. I had overlooked this object in the General Catalogue, and was not aware that it was No. 1440, and therefore fixed its position by comparing it with O. Arg. S. 2493. The nebula follows that star 29ˢ, and is 91″.1 north. This gives for the nebula (1860):

R. A. $3^h\ 38^m\ 43^s$
Decl. $-\ 18°\ 42'.6$

This is almost exactly identical with the place in DREYER. It is hardly possible that I should have missed No. 1458 if any such object really existed. The other object may have been observed under conditions which made it appear much fainter than it really is.

No. 1555.

R. A. $4^h\ 13^m\ 48^s$
Decl. $+\ 19°\ 11'.2$

Not long since I found a new double star in the vicinity of HIND'S supposed variable nebula, and took occasion, when the measures of the new pair were finished, to examine the place of the nebula with the 36-inch refractor. The atmospheric conditions were always favorable. The distance of the components of the double star referred to is only 0″.16, and therefore it would have been useless to turn the telescope in that direction when the definition was inferior.

The nebula is easily found from the 8.7-m star, D.M. + 19°, 704, which is 15ˢ p and 4′ s. The place of the nebula, as given by DREYER, on the authority of D'ARREST, is identical with that of D.M. + 19°, 706, the magnitude of which was estimated by ARGELANDER as 9.4; and this is *T Tauri* of the variable star catalogues. On October 11th, this star was estimated to be about 11.5 mag., but subsequent examinations indicated that it should be placed lower in the scale. I measured the difference in declination between this and the brighter star 15ˢ preceding; but finding the two stars could be connected directly by using the lowest micrometer eye-piece, the angle and distance were also measured on two nights. The measures in declination are as follows:

1890.775	Diff. Decl. + 243″.65
.777	243 .40

The direct measures are:

1890.775	43°.5	336″.31	8.3 . . . 11.5
.777	43.8	336.07	8.4 . . . 12.5

This small star, if it is a star, is placed within a very small condensed nebula. It is somewhat elongated in the direction of 151°.7. A rough reading of the wires gave 4″.4 for the length of the nebula in this direction. It is less extended on the opposite side of the star or nucleus, with a shorter diameter of perhaps half that measured. It was examined with various powers, but it was impossible to say whether or not it had a disc like that of an ordinary star. If it were the bright nucleus of the small nebula, it would probably present the same stellar appearance. It will be noticed that this description of the nebula does not correspond with that in the early observations, where it was noted, when it was seen at all, as about 1′ in diameter.

On October 15th, I asked Mr. BARNARD to examine this region with the large telescope. His great experience in work of this kind, and remarkable acuteness of vision in detecting extremely faint, diffused objects, which would escape the ordinary observer, are well known. After careful attention he was able to see an excessively faint, round nebula, about ¾′ from the one previously described, in the estimated direction of 185°. This faint nebulosity was about 40″ or 50″ in diameter, and apparently not connected with the variable, and was of nearly the last degree of faintness for the light-power of the large instrument. It is, perhaps, too faint for any other telescope. I should not have seen it independently. Neither Mr. BARNARD nor myself, on any occasion, could see the slightest trace of the $O\Sigma$ nebula (seen also at times by D'ARREST, TEMPEL, and others, but invisible in the ROSSE reflector), which should be 15ˢ preceding HIND's, nor any nebula in the immediate vicinity. Subsequently we looked at the small nebula with the 12-inch telescope, by way of getting a better estimate of its magnitude, and found that it was a very faint object, and in appearance precisely like any ordinary star of that magnitude. The nebulous surrounding was completely lost with the smaller instrument. I do not think it can be any brighter now than 12.5-m of the scale used in my double-star observations.

On the night of November 1st, Mr. KEELER examined the nebula with the small spectroscope attached to the 36-inch telescope, and found that it was probably of the usual gaseous type, although on account of the extreme faintness of the nebula only the principal line at λ 5005 was visible. The spectrum of the nucleus could not be seen.

Nothing seems to be definitely known of the period of this variable, *T Tauri*, and it seems to have been as much neglected as the nebula. It should be easy to determine, at least approximately, the extent and time of its change, and it is to be hoped that variable star observers will give this object systematic attention. An instrument of moderate size will answer this purpose. It is probably now not far from its minimum brightness, in which case the variation must have a range of at least three magnitudes. A large aperture will be necessary to ascertain whether the small nebula, which is now visible immediately about the nucleus or star, is also subject to any change.

It was again looked at several times in September and October, 1891. At first it was thought to be a little brighter than in 1890, but subsequent examinations made this doubtful. It was also looked at with the 12-inch in 1890 and 1891, and there was no apparent change in the interval. Any variation would perhaps be more easily detected with this instrument than with the larger aperture. It remains to be seen whether there is any change after all in this object.

About 20′ north of this is the so-called variable, *U Tauri*. This is a double star, first noted as such by KNOTT. I have made the following measures:

1891.772	203°.6	3″.25	9.3 . . . 9.4
.804	204.1	3.03	9.0 . . . 9.2
.810	203.7	3.08	9.0 . . . 9.1
1891.79	203.8	3.12	9.1 . . . 9.2

The only other measures with which I am acquainted are:

1868.01 202°.1 3″.10 9.9 . . . 9.9 Knott 2 n

Of course, very little, if any, change would be expected in a pair of this kind. The variability of this star does not seem to have been satisfactorily shown. On the whole, it is doubtful if there has been any change in the magnitude.

Nos. 1721, 1725, and 1728.

These three nebulæ, all in the same field, were discovered by BARNARD, in 1886, at Nashville, with a 6-inch refractor (*Sid. Mess.*, January, 1886, and *Ast. Nach.*, 2755). The places in DREYER are as follows:

No. 1721	$4^h\ 52^m\ 40^s$	$-11°\ 20'.6$
No. 1725	4 52 55	−11 20.9
No. 1728	4 53 5	−11 20.6

They were subsequently discovered independently by SWIFT, and given in his Third Catalogue. The places in DREYER are taken from this list. They are faint objects in the 36-inch, and are very much alike generally, but the preceding one is perhaps a little the brightest. The following one is extended in the direction of about 190°. All are considerably brighter in the middle. No. 1723 (TEMPEL), a short distance north of this group, is much like the others, but a little brighter. It is within a small triangle of stars, two of which are in the S.D. as 9-m, and the other is about 10-m.

I have measured the relative positions of BARNARD'S nebulæ (1891.845), as follows:

1721 and 1725	P = 121°.4	D = 94″.1
1725 and 1728	61 .6	78 .3

From these measures 1725 follows 1721 5ˢ.4, and is 49″.0 south; and 1728 follows 1725 4ˢ.7, and is 37″.2 north. The first of these I compared with an 8.4-m star preceding (L. 9349). The nebula is $1^m\ 52^s$ following, and 90″.0 north. Applying these differences to the position of the star, we have the following as the places of the nebulæ for 1860:

No. 1721	$4^h\ 52^m\ 41^s$	$-11°\ 19'.9$
No. 1725	4 52 46	−11 20.7
No. 1728	4 52 51	−11 20.1

No. 1788.

R. A. $4^h\ 59^m\ 57^s$)
Decl. $-\ 3°\ 32'.7$)

This is one of the discoveries of the first HERSCHEL (V. 32). The description in DREYER is "B, c L, R, b M**15.* 10, 1½′ 318°, inv. in the nebulosity." The large telescope shows that the brighest part of the nebulosity is around a star 11.5-m centrally placed, but it extends to the star referred to by HERSCHEL. This star is S.D. (3°) 1013, where it is called 9.5-m. There is no star near the central star, and I do not know what is meant by the reference in the description given above. It would seem to refer to a triangle of 15-m stars within the nebula. I have measured the distance and angle of the 11.5-m star from the 9.5-m:

1891.845	P = 137°.4	D = 99″.07

Between these two there are two faint stars, forming a wide pair, perhaps 6″ or 8″ apart, about one third of the distance from the 11.5-m star toward the other. There is also another faint star a little following the middle of the line joining the same stars.

Barnard.

R. A. $5^h\ 14^m\ 33^s$)
Decl. $+\ 3°\ 20'.7$)

This double nebula was discovered by BARNARD in 1888 with the 12-inch telescope of the LICK Observatory. It is 55ˢ preceding, and 4′ south of the wide double star 23 *Orionis* (Σ 696). The two nebulæ with a 10½-m star form a nearly equilateral triangle. Calling the nebulæ A and B in order of R. A., I have measured them with reference to each other, and also from the small star:

A and B.

1891.854	P = 115°.2	D = 36″.32
.893	114.5	36.03
1891.87	114.8	36.17

10½-m Star and A.

1891.854	246°.3	30″.42
.893	247.0	29.55
1891.87	246.6	29.98

10½-m Star and B.

1891.854	169°.8	25″.91
.893	169.5	24.83
1891.87	169.6	25.37

The preceding one of the two is the brighter, and is a little larger than the other. They are faint objects even in the large telescope, and without any well-defined nucleus. The place given above is for A, and obtained from measures by BARNARD of its position with reference to D.M. (3°) 864.

In sweeping for these objects I found another nebula in the immediate vicinity, which is new. This is similar in appearance to the others, but one or two magnitudes fainter. The position of this was measured from a 9-m star, as follows:

D.M. (3°) 863 and Nebula.

1891.854	P = 317°.7	D = 132″.8
.893	318.1	131.7
1891.87	317.9	132.2

Applying these measures to the place of the star as given in the *Albany Catalogue*, we have for the nebula (1860):

R. A. $5^h\ 14^m\ 40^s$
Decl. $+\ 3^\circ\ 10'.4$

No. 1931.

R. A. $5^h\ 22^m\ 9^s$
Decl. $+\ 34^\circ\ 8'$

This is one of the discoveries of HERSCHEL I. It has been drawn by HERSCHEL II. (*Phil. Trans.*, 1833), and by D'ARREST. HERSCHEL, in his observations of nebulæ, describes it as "a nebula including a triple star forming an equilateral triangle; sides = 4″; stars = 11, 12, 14-m." The triple was entered as No. 367 of his *Second Catalogue of Double Stars* (*Memoirs R.A.S.*, III.), with the following note: "One of the most curious objects in the heavens. It is a triple star forming an equilateral triangle, and placed exactly in the center of a small circular nebula which extends a little beyond the stars." No measures were made, but the distance was estimated as 7″.

In 1876 I looked at this with the 6-inch and found the nebula faint with that aperture, but the three stars were easily seen. With the 18½-inch in 1878 I noted several other stars in the group, just outside of the nebula. The 36-inch telescope now shows that one of the stars of the triangle is double, having an exceedingly faint attendant at a distance of a little more than 2″. This is a difficult pair under ordinary conditions with this telescope, and probably could not be seen at all in any other telescope with which this object has been observed. In the following measures, A, B, and C are the stars which form HERSCHEL'S triangle:

A and B.

	°	″	
1891.753	234.3	7.88	9.5 . . 10.0
.766	233.0	8.16	9.5 . . 10.0
.785	234.1	7.97	9.5 . . 9.7
1891.77	233.8	8.00	9.5 . . 9.9

A and C.

	°	″	
1891.753	309.9	10.33	. . 11.5
.766	311.4	10.62	. . 10.5
.785	309.0	10.65	. . 11.5
1891.77	310.1	10.53	. . 11.2

B and D.

	°	″	
1891.766	327.9	2.40	. . 15.0
.785	321.4	2.22	. . 15.5
1891.77	324.6	2.31	. . 15.2

There is a 14-m star about 6″.8 from A in the direction of 18°.7. HERSCHEL estimated the angles of AB and AC as 220° and 280°, respectively, and the distance of each 7″. The only other measures which I have found were made with the large reflectors at Parsonstown. Some of the distant stars were observed, but the close star was not seen. The measures of the stars in the triangle are:

	°	″	
1873.775	239.2	7.1	AB
1873.775	310.5	9.7	AC

No. 1988.

R. A. $5^h\ 29^m\ 4^s$
Decl. $+\ 21^\circ\ 7'.7$

This is CHACORNAC'S so-called variable nebula near *ζ Tauri*. DREYER states that TEMPEL pointed out many years ago that the supposed nebula was only the false image of the star. With the 36-inch there is not the least trace of any nebulosity in this place, and there is no doubt of the correctness of TEMPEL'S explanation. Too much time has been wasted in looking for this object, and particularly since there was no reason whatever for believing in its existence after CHACORNAC himself failed to see it in 1862. Possibly some of the nebulæ may change, but the evidence of the actual disappearance of any object of this kind is very unsatisfactory, to say the least.

No. 2182.

R. A. $6^h\ 2^m\ 42^s$
Decl. $-\ 6^\circ\ 19'.0$

This is a large nebula surrounding a wide double star. The nebula is IV. 38 (= *h* 381). The double star is H. 2298. It is much too wide to be of any interest as a double star. The description in *h* 381 is: "The large star of a double star has a very strong nebulous burr." The double was estimated (Fifth Catalogue) 90°: 35″: 8–9 . . 10.

The large telescope shows that the principal star is centrally placed in a faint nebula, which is considerably extended in all directions. It is very much like the planetary nebulæ so far as the

central star is concerned, but lacks the definite boundary which characterizes all nebulæ of that class. The large telescope also shows, what is of more interest than anything heretofore seen in connection with this object, that this central star is a very close pair. It is much too difficult to have been discovered with the large reflectors with which the nebula has been observed. I have not looked at it with the 12-inch here; under favorable conditions the elongation would probably be detected, but it could not be properly measured with such an aperture. My measures are as follows:

A and B.

	°	″	
1891.854	122.5	0.52	8.7 . .
.859	126.2	0.48	8.5 . . 8.7
.903	124.7	0.45	8.5 . . 8.6
1891.87	124.5	0.48	8.6 . . 8.8

AB and C (= H. 2298).

	°	″	
1891.854	92.6	43.87	. . 10.5
.859	92.8	44.00	. . 11.0
.903	93.4	43.74	. . 10.5
1891.87	92.9	43.87	. . 10.7

There are no other measures of C. The principal star (AB) is S.D. (6°) 1431 (= Schj. 2066), and its position for 1860 is:

R. A. $6^h\ 3^m\ 41^s.6$
Decl. $-\ 6°\ 18'.3$

This is the place of the nebula, and therefore there is an error of about 1^m in the catalogue R. A. given above. This star is 9.0-m in the S.D., and 9.3 in Schjellerup.

There are a number of other nebulæ in this vicinity which were also examined. No. 2167 is described as "a star 7-m, with a pretty strong nebulous atmosphere." I could not see any difference between this and other stars of similar magnitude in the neighborhood. I have sometimes thought that all of the stars in this region of the heavens had a glow about them not generally found elsewhere, but this may be only optical or imaginary.

No. 2170 is described as "a star 9-m, in a very faint, pretty large nebula, extended in 170°." The nebulous light around the small star, S.D. (6°) 1414, is very marked, and must be at least 2′ or 3′ in diameter. It is extended nearly north and south, as described in the catalogue.

No. 2183, discovered by D'Arrest, is very small, and has a minute but relatively bright central condensation, which may be a faint star.

No. 2185 closely follows the last, but is too large to be seen to any advantage with the lowest micrometer eye-piece, and its extent could not be properly estimated. The brightest part of it seems to be about a star 10–11-m.

No. 7114.

R. A. $21^h\ 36^m\ 13^s$
Decl. $+\ 42°\ 12'.3$

This is the well-known "Nova Cygni." In looking up this star I have relied entirely upon the admirable catalogue and accompanying map of the surrounding stars by Copeland and Lohse (*Copernicus*, II., 101). The arrangement of the catalogue is perfect in every respect, and the chart showing the relative positions of the stars could not be improved. Both should serve as models for all works of this kind. I may say, in addition, that it is remarkably complete in reference to faint stars. The large telescope shows very little more.

I estimated this star (1891.731) as about 13.5-m. The nearest star to the "Nova" given by Copeland, 314°.2 : 19.1, is a little fainter, or about 14-m. The 36-inch shows nothing closer. At times the new star did not seem to have a perfectly stellar appearance under moderately high powers, but rather to resemble an exceedingly minute nebula. This appearance, however, may not be real. The star is too faint to allow one to decide a question of this kind with any certainty. I did not make any measures from surrounding stars, as that has been very thoroughly done by the authors of the paper referred to.

They have the following notes concerning some of the faint stars:

No. 20 (14.5-m). "Perhaps double."
No. 40 (14.5-m). "This star is probably double or multiple."
No. 82 (13.9-m). "Double?"
No. 88 (13.8-m). "Double?"

I have examined these stars, with the following results:

No. 20. While this is not double, strictly speaking, there is another star of nearly the same magnitude at a distance of 15″ or 20″, and that is probably what is referred to.
No. 40. There are two faint stars about 8″ or 10″ apart.

No. 82. I could not see any other star near this.
No. 88. This is a very faint pair of stars, with a distance of perhaps 2″ or 3″.

No. 7173.

R. A. $21^h\ 53^m\ 53^s$
Decl. $-\ 32^\circ\ 38'.1$

There are other nebulæ in this group (Nos. 7172, 7174, and 7176). They were accidentally picked up with the 12-inch, and, in consequence of a blunder in referring to DREYER, they were supposed to be new, and therefore observed as given below. The comparison star is from the *Cardoba Catalogue:*

GOULD 30,117 and No. 7173.

1891.758 P = 30°.1 D = 361″.8

GOULD 30,117 and No. 7176.

1891.758 P = 44°.9 D = 350″.1

These measures give for the nebulæ (1860):

No. 7173. R. A. $21^h\ 53^m\ 53^s$, Decl. $-\ 32^\circ\ 38'.7$

No. 7176. R. A. $21^h\ 53^m\ 58^s$, Decl. $-\ 32^\circ\ 39'.8$

The last named, No. 7176, is double in HERSCHEL, the companion being No. 7174. With the 36-inch, with which it was subsequently examined, it appears to be one nebula, with a second very faint nucleus or condensation. I made the following measures with the large telescope (1891.766):

No. 7173 and No. 7176.	P = 130°.1	D = 89″.44
No. 7176 and No. 7174.	238 .2	25 .62

No. 7172, which is about 5½′ north of No. 7173, was not measured.

No. 7287.

R. A. $22^h\ 50^m\ 54^s$
Decl. $-\ 22^\circ\ 51'.1$

Discovered by MÜLLER at the MCCORMICK Observatory. It is described, "Excessively faint, slightly nebulous double star." I found two very faint objects about 20″ apart. It may possibly be a double nebula, but the following component seems to be a faint star only. The preceding one is undoubtedly a faint nebula. It is a little brighter in the middle, giving it a stellar appearance. Rough measures of the two give P = 60°.5; D = 20″.7.

No. 7403.

R. A. $22^h\ 45^m\ 57^s$
Decl. $+\ 0^\circ\ 44'.3$

This was discovered by COOLIDGE at the Harvard Observatory. The description is, "Star slightly nebulous." A careful examination (1891.728) shows that there is certainly nothing of the kind in the assigned place. It should be about 7′ north of a 9-m star, D.M. (0°) 4935. In sweeping over this region I found a moderately bright nebula, which is probably the object in question. It is 38ˢ following, and 39″.5 north of the D.M. star mentioned above. This gives as the place of the nebula (1860):

R. A. $22^h\ 46^m\ 37^s$
Decl. $+\ 0^\circ\ 38'.2$

The nebula has a 10-m star 113″.0 distant in the direction of 230°.4.

About 15′ north of this, and a little preceding, there is a cluster of five faint nebulæ (Nos. 7396, 7397, 7398, 7401, and 7402), all but the first discovered with the ROSSE reflector. These were readily found, and appeared to be in the catalogue places.

No. 7447.

R. A. $22^h\ 53^m\ 6^s$
Decl. $-\ 11^\circ\ 16'.7$

Described in the catalogue, "Star 11–12-m in neb." In the final notes it is stated that this was not found by TEMPEL on several occasions (*Ast. Nach.*, 2284). I examined this region very thoroughly on October 29th without finding anything in the least suggestive of a nebula of any kind. In or very near the catalogue place there is a 11–12-m star, but there is nothing nebulous about it. A little n. p. the place there is a faint triple star, AB 200° : 2″; AC 270° : 10″, and perhaps with a small aperture this group might be mistaken for a nebula. The place was carefully examined again on a subsequent night, with similar results. This object certainly does not exist.

Nos. 7472, 7477, and 7482.

These three nebulæ are given in the General Catalogue as follows:

No. 7472	$22^h\ 56^m\ 34^s$	$+\ 2^\circ\ 18'.0$	O. Struve.
No. 7477	22 57 34	+ 2 21 .9	D'Arrest.
No. 7482	22 58 33	+ 2 19 .0	Marth.

It seemed a little strange that three separate objects should be distributed in this way, and a

careful examination showed that all the observations related to one object. I went over the whole vicinity on two nights, and I am certain that there is only one nebula here. That is 1^m 23^s preceding, and 30″.4 south of the 8.2-m star, D.M. (2°) 4609 (= LALANDE 45,206). Applying these differences to the place of the star from SCHJELLERUP, we have for the nebula (1860):

R. A. 22^h 58^m 31^s
Decl. + 2° 17′.2

This agrees substantially with MARTH'S position, and his description is also correct.

No. 7693.

R. A. 23^h 25^m 59^s
Decl. — 2° 3′.9

This was discovered by HALL, in 1881, while observing FAYE'S Comet (*Ast. Nach.*, 2394). It is described as a "small nebula, or nebulous star." This was examined on two nights with the large telescope. It is a small, faint nebula, a little brighter in the middle, but there is nothing stellar in its appearance. There is a small star near it, with which it was compared:

Neb. and 13-m Star.

1891.675 P = 111°.2 D = 83″.72

For place it was compared with the nearest catalogue star, S.D. (2°) 5982:

Star and Neb.

1891.675 P = 112°.4 D = 277″.4

Applying these differences to LAMONT'S place of the S.D. star, gives for the nebula (1860):

R. A. 23^h 25^m 59^s
Decl. — 2° 3′.7

No. 7804.

R. A. 23^h 54^m 9^s
Decl. + 6° 58′.1

The description is, "Very faint double star, nebulous?"; and in the final notes DREYER says: "Found by SCHWEIZER (*Observations de Moscou*, II., 115), and observed by BREDECHIN in 1875. Described as F, E, a little brighter s. p. ENGELHARDT, in four observations could only see a double star without nebulosity."

I examined this region very carefully on two nights. The faint pair mentioned was found; but there was no trace of nebulosity about it, or anywhere in the vicinity. I measured the double star as follows:

1891.675 55°.6 9″.79 12.5 . . 13.0

To find out whether this is in the place assigned to the supposed nebula, I measured it directly from the nearest catalogue star, D.M. (6°) 5233. This is a small star, 8.7-m. The principal star of the faint pair is 160″.4 distant in the direction of 350°.0, giving for the place of the nebula (1860):

R. A. 23^h 54^m 7^s
Decl. + 6° 58′.2

This shows that it was certainly the object taken for a nebula by SCHWEIZER, and observed by BREDECHIN. The comparison star used above is a wide double. A single setting of the wires gave 266°.1 : 15″.2. I ascertained later that it had been measured by DUNÉR in 1869. He found 265°.3 : 15″.26.

New Nebulæ.

In addition to the new nebulæ incidentally noted in the foregoing observations, I found the two given below. They are both in the field with a 9.5-m star, D.M. (40°) 608, and I have measured them directly from this star. The following nebula of the two is double. The nuclei are small, and fairly well defined. The other is only a little brighter in the center, and considerably diffused. I have called the magnitudes of the nuclei of the double nebula each 14.

D.M. Star and Neb. I.

1891.673	P = 288°.8	D = 109″.72
.689	288.8	110.83
1891.68	288.8	110.27

D.M. Star and Neb. II.

1891.673	285°.5	169″.19
.689	285.6	169.34
1891.68	285.5	169.26

Neb. II (Nuclei).

1891.673	323°.1	17″.02
.689	321.7	18.06
1891.68	322.4	17.54

Applying these measures to the D.M. place of the star, we have for the nebulæ (1860):

Neb. I.	2^h 40^m 49^s	+ 40° 28′.5
Neb. II.	2 41 12	+ 40 28.6

The only catalogue nebula in the immediate vicinity is one discovered by SWIFT (No. 1086). This is larger than I., and brighter than either.

NEW DOUBLE STARS

DISCOVERED AT THE

LICK OBSERVATORY IN THE YEARS 1888 TO 1892.

By S. W. BURNHAM.

FOURTEENTH CATALOGUE OF NEW DOUBLE STARS DISCOVERED AT THE LICK OBSERVATORY.

By S. W. Burnham.

The following is a catalogue of the double stars discovered by me with the 36-inch and 12-inch refractors of the Lick Observatory in August, September, and October of the present year (1888). In this list, as a rule, only the stars are given which have been measured on at least three nights. Unless otherwise stated in the notes, the new double stars were discovered with the 12-inch telescope. The aperture of the instrument with which the micrometrical measures were made is given in the last column.

β 1026. L. 58.

R. A. $0^h\ 5^m\ 48^s$
Decl. $+\ 52^\circ\ 57'$

	°	″		
1888.733	326.0	...	8.0 . . . 9.0	12
.736	338.9	0.51	8.0 . . . 8.5	12
.785	322.0	0.43	8.0 . . . 9.0	12
.796	331.7	0.50	8.5 . . . 9.0	12
1888.76	329.6	0.48	8.1 . . . 8.9	

This star is 7^m in L, and 6.5 in DM.

β 1027. W_2 0. 200.

R. A. $0^h\ 8^m\ 44^s$
Decl. $+\ 20^\circ\ 50'$

	°	″		
1888.815	187.3	1.60	7.0 . . 10.0	36
.821	186.1	1.57	7.5 . . 10.5	12
.832	187.1	1.44	7.0 . . 10.5	12
1888.82	186.8	1.54	7.2 . . 10.3	

Discovered with the 36-inch. (See p. 16.)

β 1028. γ Cassiopeiae.

R. A. $0^h\ 48^m\ 50^s$
Decl. $+\ 60^\circ\ 1'$

	°	″		
1888.668	255.0	2.17	. . 11.0	36
.671	255.2	2.13	. .	36
.678	254.7	2.03	. . 11.0	36
.681	257.5	2.33	. . 11.5	12
.695	254.9	2.26	. . 11.0	36
.733	258.0	2.17	. . 11.0	12
1888.69	255.9	2.18	. . 11.0	

Discovered with the 36-inch. Well seen with the 12-inch. (See p. 22.)

The following measures were made of the distant companion (= β 499):

	°	″		
1888.678	348.8	52.53	. . 14.0	36
.695	348.4	52.35	. . 13.0	36

The two sets of measures indicate no change:

	°	″		
1878.80	348.6	52.27	β	2 n
1888.68	348.6	52.44	β	2 n

β 1029. ζ Piscium.

R. A. $1^h\ 7^m\ 27^s$
Decl. $+\ 6^\circ\ 56'$

B and C.

	°	″		
1888.681	244.0	0.98	. . 11.5	12
.695	248.2	0.91	. . 10.0	12
.714	254.7	0.88	. . 11.5	12
.720	247.1	0.94	. . 11.5	12
.733	249.6	0.96	. . 11.0	12
1888.71	248.7	0.93	. . 11.0	

A and B (= Σ 100).

	°	″		
1888.681	63.4	23.75	. .	12
.695	64.0	23.86	. .	12
.698	63.1	23.91	. .	12
.714	63.5	23.61	. .	12
.733	63.6	23.48	. .	12
1888.71	63.5	23.72	. .	

The bright stars appear to be relatively fixed, but with a common proper motion. (See p. 24.)
STRUVE found:

1832.83	63°.7	23".46

β 1030. W_2 III. 5.

R. A. 3h 3m 11s
Decl. + 21° 17′

1888.821	162°.1	0".64	8.0 . . . 8.0	12
.832	168.3	0.63	8.5 . . . 8.5	12
.835	163.3	0.47	8.6 . . . 8.6	12
1888.83	164.6	0.58	8.4 . . . 8.4	

Discovered with the 36-inch.

β 1031. α Tauri. (Aldebaran.)

R. A. 4h 29m 2s
Decl. + 16° 16′

C and D.

1888.772	286°.0	3".02	. . 12.0	36
.813	279.5	2.00	9.0 . . 12.0	36
.835	277.7	2.00	9.0 . . 12.0	36
1888.81	281.1	2.34	9.0 . . 12.0	

A and B (= β 550).

1888.813	110°.0	30".88	. .	36
.835	109.0	30.91	. .	36
1888.82	109.5	30.90	. .	

A and C (= Σ 2 App. II.).

1888.772	35°.7	116".98	. .	36
.813	34.5	116.88	. .	36
.832	34.5	116.86	. .	12
1888.81	34.9	116.91	. .	

The duplicity of the HERSCHEL companion was detected with the 36-inch. (For later measures, see p. 38.)

β 1032. σ Orionis.

R. A. 5h 32m 43s
Decl. — 2° 40′

A and B.

1888.775	358°.3	0".18	4.0 . . . 6.0	12
.813	356.2	0.27	4.0 . . . 6.0	36
.818	356.4	0.27	. . .	36
.832	357.1	0.32	. . .	36
1888.81	357.0	0.26	. . .	

AB and C (= Σ 762).

1888.832	236°.7	11".04	. . .	12
.832	236.8	11.42	. . .	36
.851	237.9	11.24	. . .	12
1888.84	237.1	11.23	. . .	

AB and D (= Σ 762).

1888.832	83°.9	12".90	. . .	12
.832	83.2	12.97	. . .	36
.851	82.8	12.66	. . .	12
1888.84	83.3	12.84	. . .	

AB and E.

1888.851	60°.5	41".18	. . .	12

This star has been known as a wide triple since H. There is no change in old companions. Σ gives:

1831.42	236°.5	11".00
1831.20	84.5	12.86

The close pair is difficult with the 12-inch, with which it was discovered. The close pair is moving. (See p. 49.)

β 1033. ν^2 Sagittarii.

R. A. 18h 47m 51s
Decl. — 22° 49′

1888.681	104°.0	1".37	5½ . .	11.0	12

Discovered with the 36-inch.

β 1034. 7 Aquarii.

R. A. 20h 50m 25s
Decl. — 10° 9′

1888.600	164°.6	1".90	7.0 . . 13.0	12
.613	168.1	2.03	6.0 . . 12.0	12
.714	165.3	2.21	6.0 . . 11.0	12
.731	162.9	2.15	6.0 . . 11.5	12
.733	164.0	2.18	6.0 . . 11.0	12
1888.68	165.0	2.09	6.0 . . 11.7	

Found with the 36-inch.

β 1035. B.A.C. 7422.

R. A. 21h 17m 16s
Decl. — 26° 4′

1888.714	199°.2	0".96	8.0 . . 10.5	12
.733	199.9	1.08	8.0 . . 11.0	12
.777	197.1	1.10	8.0 . . 10.5	12
1888.74	198.7	1.05	8.0 . . 10.7	

β 1036. Yarn. 9529.

R. A. $21^h\ 40^m\ 59^s$
Decl. $-17^\circ\ 51'$

	°	″		
1888.675	204.8	4.62	7½ . . 11.5	12
.763	204.4	4.67	8.0 . . 11.0	12
.777	205.7	4.30	8.5 . . 11.0	12
1888.74	205.9	4.53	8.0 . . 11.0	

β 1037. W_1 XXII. 854.

R. A. $22^h\ 41^m\ 56^s$
Decl. $+12^\circ\ 22'$

	°	″		
1888.777	226.6	. . .	. .	12
.796	221.9	0.72	8.5 . . 10.8	12
.832	228.2	0.68	8.5 . . 10.5	12
.835	220.9	0.58	9.0 . . 11.0	12
1888.81	224.4	0.66	8.7 . . 10.8	

Found with the 36-inch. The preceding star of a wide pair.

β 1038. D.M. (41°) 1488.

R. A. $23^h\ 45^m\ 31^s$
Decl. $+41^\circ\ 25'$

	°	″		
1888.681	160.5	0.64	8.0 . . . 8.0	12
.755	157.5	0.55	8.5 . . . 8.5	12
.763	154.9	0.62	8.3 . . . 8.3	12
1888.73	157.6	0.60	8.3 . . 8.3	

In D.M. $6^m.7$, but only $7^m.4$ in RADCLIFFE. This pair is $O\Sigma$ 510, but the identity of the two was not noticed at the time this catalogue was first prepared.

FIFTEENTH CATALOGUE OF NEW DOUBLE STARS DISCOVERED AT THE LICK OBSERVATORY.

By S. W. Burnham.

The double star observations which follow comprise that work with the 36-inch Clark refractor since the publication of my last list (A. N. 2875), and were principally made during the first four months of the present year (1889). A few measures with the 12-inch telescope, which were omitted in the first series, are included in this list; but substantially all the measures have been made with the large refractor, as indicated in the last column of the catalogue following.

The micrometer for the large telescope was made by Fauth, but after the Clark plan in all essential particulars; and, after some minor changes, was made to work most satisfactorily. The bright-wire illumination is very perfect; and no star or nebula which can be seen at all is too faint for measurement. The light is under perfect control, and can be instantly changed from the maximum brilliancy of the wires to invisibility. Either a part or all of the light, depending upon the object under observation, is passed through red glass before reaching the wires. The illustration and description of the Clark micrometer for the 12-inch refractor, with the device for a self-adjusting illuminating lamp, given in *Monthly Notices* for March, 1882, will apply equally well to the large micrometer.

The micrometer eye-pieces give powers (approximately) of 450, 670, 1000, 1350, 2000, 2700, and 3300. For very close pairs the last three were generally used when the air was sufficiently steady. In measuring very unequal pairs, with distances of 1″.5 and upwards, the two lower powers have been usually employed. It did not seem worth while to indicate the particular power used in each of the measures.

In looking for new pairs, I have for the most part examined only naked-eye stars; hence, the large proportion of bright stars. Comparatively little time has been given to the discovery of new objects; in fact I have purposely avoided finding them any faster than they could be thoroughly measured, and have rejected many new pairs among the smaller stars which incidentally came into the field. As far as possible, at least three measures have been made of each pair, new and otherwise. The present work comprises about four hundred measures of both classes of stars. This, under the circumstances, is perhaps as much as could be

β 1045. 99 Tauri.

R. A. $4^h\ 50^m\ 32^s$
Decl. $+\ 23^\circ\ 46'$

1889.091	6.1	6.28	6.0 . . 12.5	36
.093	6.5	6.26	6.0 . . 12.0	36
.099	5.9	6.37	6.0 . . 12.5	36
1889.09	6.2	6.30	6.0 . . 12.3	

(For later measures, see p. 42.)

β 1046. 9 Aurigae.

R. A. $4^h\ 56^m\ 59^s$
Decl. $+\ 51^\circ\ 26'$

A and B.

1888.922	94.7	6.21	5.5 . . 13.0	36
.925	93.5	6.39	. . 13.0	36
.928	93.2	6.27	. . 12.0	36
1888.92	93.8	6.29	5.5 . . 12.7	

A and C (= H_1 VI. 35).

1888.922	60.8	89.91	. . . 9.0
.928	60.9	89.94	. . . 9.0
1888.92	60.8	89.92	. . . 9.0

This wide pair has not been measured before since it was entered by HERSCHEL, more than a century ago. His measures are:

1783.30	62.0	79.50

β 1047. Aurigae 47.

R. A. $5^h\ 2^m\ 13^s$
Decl. $+\ 27^\circ\ 53'$

B and C.

1889.091	76.3	0.37	9.0 . . . 9.3	36
.093	74.5	0.40	8.7 . . . 9.5	36
.104	75.2	0.54	8.5 . . . 8.8	36
1889.09	75.3	0.44	8.7 . . . 9.2	

The smaller component of this pair is a close and difficult double, and might be easily overlooked by instruments of moderate aperture. (See p. 43.)

A and BC (= Σ 645).

1889.091	26.8	11.60	7.5 . . .	36
.093	26.2	11.79	7.0 . . .	36
.104	26.7	11.68	7.0 . . .	36
1889.09	26.6	11.69	7.2 . . .	

The wide pair was first observed by HERSCHEL. There does not seem to be any change in angle or distance:

1783.74	26.0	13.60	H_1
1829.90	26.8	11.71	Σ

HERSCHEL's distance is probably too large.

β 1048. L. 10437.

R. A. $5^h\ 26^m\ 37^s$
Decl. $-\ 1^\circ\ 41'$

1889.128	359.0	2.29	6.0 . . 10.5	36
.131	357.3	2.14	6.5 . . 11.0	36
.134	358.4	2.18	. .	36
1889.13	358.2	2.20	6.2 . . 10.7	

In HEIS 6m, and GOULD, 6½m.

β 1049.

R. A. $5^h\ 27^m\ 3^s$
Decl. $-\ 1^\circ\ 48'$

C and D (new).

1888.906	295.2	0.83	9.0 . . 10.0	36
.911	298.5	0.78	. .	36
.914	296.6	0.69	8.5 . . 9.0	36
.928	294.3	0.74	8.5 . . 9.0	36
1888.91	296.1	0.76	8.7 . . 9.7	

A and B (= Σ 734).

1888.906	355.0	1.68	. .	36
.911	352.6	1.59	. .	36
.914	357.3	1.66	. .	36
.928	355.9	1.53	7.0 . . 8.0	36
1888.91	355.2	1.61	7.0 . . 8.0	

A and C (= H_1 V. 119).

1888.906	242.8	29.53	. .	36
.911	242.5	29.45	. .	36
.928	243.1	29.28	. .	36
1888.91	242.8	29.42	. .	

The old stars seem to be relatively fixed. Some of the prior measures are:

1832.93	356.4	1.78	A and B	Σ
1878.99	354.9	1.75		β
1783.76	248.4	30.20	A and C	H_1
1832.48	243.1	29.29		Σ
1879.02	242.9	29.47		β

β 1050. Bond 974.

R. A. $5^h\ 30^m\ 55^s$
Decl. $-\ 5^\circ\ 33'$

1888.928	283°.0	0″.64	. .	36
1889.077	284.4	0.62	10.5 . . 12.0	36
.091	283.5	0.75	10.5 . . 11.5	36
1889.03	283.6	0.67	10.5 . . 11.7	

A difficult pair of small stars in the nebula of *Orion*. It is $1^m\ 32^s$ following θ^1 *Orionis*, and 5′ south.

β 1051. Bond 1096.

R. A. $5^h\ 32^m\ 1^s$
Decl. $-\ 4^\circ\ 57'$

1889.077	22°.6	0″.82	10.0 . . 10.7	36
.091	25.3	0.73	9.8 . . 10.5	36
.093	26.2	0.71	10.5 . . 10.8	36
1889.09	24.7	0.75	10.1 . . 10.7	

Another difficult pair in the nebula of *Orion*. It is No. 1096 of BOND's Catalogue. A star $7\frac{1}{2}^m$ p 22°.4, and 2′ 34″ n.

β 1052. L. 10776.

R. A. $5^h\ 35^m\ 39^s$
Decl. $-\ 2^\circ\ 57'$

1889.134	192°.0	0″.62	7.0 . . . 8.0	36
.137	189.4	0.59	7.0 . . . 8.0	36
.142	185.8	0.77	6½ . . . 7½	36
1889.14	189.1	0.66	7.2 . . . 8.2	

In GOULD $6^m.7$.

β 1053. Aurigae 146.

R. A. $5^h\ 45^m\ 18^s$
Decl. $+\ 37^\circ\ 19'$

1889.922	283°.2	0″.43	7.5 . . . 9.5	36

β 1054. 136 Tauri.

R. A. $5^h\ 45^m\ 47^s$
Decl. $+\ 27^\circ\ 35'$

1889.060	234°.1	14″.78	5.6 . . 11.0	36
.091	231.3	15.21	6.0 . . 12.0	36
.099	231.2	15.02	6.0 . . 12.0	36
1889.08	232.2	15.00	6.0 . . 12.0	

β 1055. Aurigae 161 = B.A.C. 1899.

R. A. $5^h\ 51^m\ 32^s$
Decl. $+\ 44^\circ\ 35'$

A and B.

1888.922	332°.9	1″.49	6.5 . .	36
.925	328.4	1.46	7.0 . . 11.0	36
.928	337.3	1.88	. . 12.0	36
1888.92	332.9	1.61	6.7 . . 11.5	

A and C (= H_1 V. 91).

1888.922	327°.0	33″.36	. .	36
.925	330.3	33.45	. . 9.0	36
.928	331.7	33.25	. . 9.5	36
1888.92	329.7	33.35	. . 9.2	

Like many others of this class, this pair has been wholly neglected since it was observed by HERSCHEL, more than one hundred years ago. The change, if any, is probably due to proper motion. HERSCHEL gives:

1783.49	315°.1	30″.05	H_1	1 n

β 1056. μ Orionis.

R. A. $5^h\ 55^m\ 47^s$
Decl. $+\ 9^\circ\ 39'$

1889.104	271°.6	16″.78	4.0 . . 14.0	36
.110	273.9	16.73	. . 14.0	36
.115	272.0	16.89	. . 13.0	36
1889.11	272.0	16.80	. . 14.0	

(See p. 51.)

β 1057. Aurigae 183.

R. A. $5^h\ 58^m\ 42^s$
Decl. $+\ 29^\circ\ 32'$

1889.091	209°.5	10″.06	6.3 . . 11.5	36
.099	209.8	9.89	6.3 . . 11.0	36
.104	209.0	10.00	6.3 . . 11.0	36
1889.10	209.5	9.98	6.3 . . 11.2	

β 1058. 4 Geminorum.

R. A. $6^h\ 3^m\ 13^s$
Decl. $+\ 23^\circ\ 1'$

1889.102	107°.4	0″.49	7.8 . . . 7.8	36
.154	101.3	0.33	6.7 . . . 7.2	36
1889.13	104.3	0.41	7.2 . . . 7.5	

An occultation of this star by *Jupiter*, November 7, 1882, was observed by WILSON at the Cincinnati Observatory, and singularly no gradual diminution of light was noticed. In a pair of this kind, with the present angle and distance, the change should have been apparent. (For later measures, see p. 52.)

β 1059. μ Geminorum.

R. A. $6^h\ 15^m\ 42^s$
Decl. $+\ 22^\circ\ 34'$

B and C.

1889.091	265°.6	0".80	10.0 . . 10.7	36
.099	266.7	0.78	9.0 . . 10.0	36
.104	267.9	0.81	10.5 . . 11.5	36
1889.10	266.7	0.80	9.8 . . 10.7	

A and BC.

1889.091	141°.1	122".68	3.0 . .	36
.099	141.0	122.34	. .	36
.104	141.0	122.46	3.0 . .	36
1889.10	141.0	122.49	3.0 . .	

A distant double companion. There are many faint stars less distant from the bright star.

β 1060. L. 13491.

R. A. $6^h\ 52^m\ 38^s$
Decl. $+\ 3^\circ\ 46'$

1889.154	56°.5	3".17	7.0 . . 12.0	36
.157	60.2	2.86	7.0 . . 12.0	36
1889.15	58.3	3.01	7.0 . . 12.0	

Large star reddish.

β 1061. κ Argus.

R. A. $7^h\ 33^m\ 55^s$
Decl. $-\ 26^\circ\ 32'$

B and C.

1889.110	229°.8	6".53	. . 13.0	36
.115	227.3	6.24	. . 14.0	36
.131	230.7	6.62	. . 14.5	36
1889.12	229.3	6.46	. . 13.8	

A and B (= H_1 III. 27).

1889.110	318°.8	10".02	4.0 . . . 4.0	36
.115	317.6	10.10	4.0 . . . 4.0	36
.131	319.0	9.83	4.5 . . . 4.5	36
1889.12	318.5	9.98	4.1 . . . 4.1	

The new star is rather difficult under ordinary conditions in this latitude. Change in the bright pair is uncertain.

β 1062. 82 Geminorum.

R. A. $7^h\ 41^m\ 23^s$
Decl. $+\ 23^\circ\ 26'$

1889.102	32°.8	4".19	6.0 . . 13.0	36
.104	34.4	3.92	. .	36
.107	29.6	4.08	6.0 . . 14.0	36
1889.10	32.3	4.06	6.0 . . 13.5	

β 1063. ξ Argus.

R. A. $7^h\ 44^m\ 15^s$
Decl. $-\ 24^\circ\ 34'$

1889.110	189°.7	4".65	4.0 . . 13.0	36
.114	186.8	4.56	3½ . . 14.0	36
.131	189.5	4.69	. . 14.5	36
1889.12	188.7	4.63	. . 13.8	

Very faint star at this altitude.

β 1064. 19 Argus.

R. A. $8^h\ 5^m\ 39^s$
Decl. $-\ 12^\circ\ 34'$

A and B.

1889.049	245°.7	1".72	6.0 . . 12.0	36
.077	242.7	1.70	6.0 . . 12.0	36
.091	245.7	2.14	6.0 . . 13.0	36
.093	245.6	1.80	6.0 . . 13.0	36
1889.08	244.9	1.84	6.0 . . 12.5	

A and C (= H_1 IV. 26).

1889.060	255°.7	70".96	6.0 . . . 9.0	36
.077	255.7	70.29	. . . 9.0	36
.091	255.9	70.78	. . . 9.0	36
1889.08	255.8	70.68	. . . 9.0	

HERSCHEL did not measure the wide pair, but it was observed later, and appears as No. 91 of SOUTH and HERSCHEL'S Catalogue of double stars. That is the only measure previous to the above.

1826.60	256°.0	70".17	Sh.

β 1065. β Cancri.

R. A. 8h 10m 0s
Decl. + 9° 33′

1889.104	295°.2	29″.40	3.0 . . 14.0	36
.107	294.8	29.43	4.0 . . 14.0	36
.131	294.1	28.59	. .	36
1889.11	294.7	29.14	3½ . . 14.0	

β 1066. L. 16489.

R. A. 8h 18m 31s
Decl. + 9° 49′

1889.107	189°.5	2″.50	6.5 . . 13.0	36
.131	188.9	2.19	7.0 . . 13.5	36
.134	184.6	2.06	7.0 . . 13.0	36
1889.12	187.7	2.25	6.8 . . 13.2	

The magnitude in D.M. is 7.6.

β 1067. o Ursae Majoris.

R. A. 8h 20m 17s
Decl. + 61° 7′

1889.142	192°.9	6″.67	3½ . . 15.5	36
.251	191.6	7.01	. . 15.0	36
.285	189.8	7.34	. . 15.0	36
1889.22	191.4	7.01	3½ . . 15.2	

An exceedingly faint companion, and difficult to measure except with a steady air. (See p. 67.)

β 1068. L. 17381.

R. A. 8h 43m 1s
Decl. + 9° 19′

A and B.

1889.131	190°.3	0″.50	7.5 . . 8.0	36
.151	193.0	0.42	8.0 . . 10.0	36
.288	186.3	0.44	7.5 . . 8.5	36
1889.19	189.9	0.45	7.7 . . 8.8	

AB and C.

1889.131	312°.8	17″.74	. . 12.0	36
.151	313.2	17.87	. . 13.5	36
1889.14	313.0	17.80	. . 12.8	

β 1069. L. 17416.

R. A. 8h 43m 40s
Decl. — 10° 34′

1889.097	61°.6	2″.02	6.0 . . 11.0	36
.091	59.5	2.40	7.0 . . 11.0	36
.093	61.3	1.98	6.8 . . 11.0	36
1889.09	60.8	2.13	6.6 . . 11.0	

β 1070. D.M. (26°) 1940.

R. A. 9h 17m 13s
Decl. + 26° 46′

1889.107	70°.4	0″.57	8.8 . . 9.5	36
.134	78.0	0.53	9.0 . . 10.0	36
.151	67.1	0.41	9.5 . . 11.0	36
1889.13	71.8	0.50	9.1 . . 10.2	

This difficult pair of small stars was noted in measuring κ *Leonis* (β 105). It is 27s f, and 4′ n of that star. The magnitude in D.M. is 8.8.

β 1071. θ Ursae Majoris.

R. A. 9h 25m 50s
Decl. + 52° 11′

1889.151	74°.9	5″.42	3.0 . . 14.0	36
.247	72.6	4.76	. . 13.5	36
.285	77.2	5.10	. . 13.5	36
1889.23	74.9	5.09	3.0 . . 13.7	

A very faint attendant, requiring good seeing to measure. As the proper motion of the bright star is about 1″.12 in the direction of 240°, the distance of the companion, if not a physical pair, will increase by nearly that amount annually. (See p. 70.)

β 1072. Sh. 110.

R. A. 9h 58m 20s
Decl. — 17° 31′

A and B.

1889.115	42°.5	10″.93	. . 12.0	36
.131	42.2	10.81	. . 12.0	36
.151	43.1	10.95	. . 13.0	36
1889.13	42.6	10.90	. . 12.3	

A and C (= Sh. 110).

1889.115	272°.8	21".28	7.0 . . . 7.2	36
.131	273.1	21.30	7.0 . . . 7.7	36
.151	273.7	21.11	6.8 . . . 7.7	36
1889.13	273.2	21.23	6.9 . . . 7.1	

From a comparison with the only other measure made of the bright stars, it would seem that there has been no relative movement.

1823.34	272°.7	21".49	Sh.

β 1073. Sextantis 101.

R. A. 10h 26m 26s
Decl. — 5° 27′

1889.291	49°.7	2".90	7.0 . . 11.5	36
.293	46.5	3.12	7.0 . . 11.5	36
.296	44.7	3.04	6.8 . . 11.5	36
1889.29	46.9	3.02	7.0 . . 11.5	

This star is 6½m in LALANDE (L. 20428), and 7m.2 in S.D.

β 1074. L. 20453.

R. A. 10h 28m 20s
Decl. + 46° 26′

1889.249	209°.7	2".28	6.0 . . 11.5	36
.285	204.7	2.19	7.0 . . 11.0	36
.291	210.8	1.84	6.3 . . 11.0	36
1889.27	208.4	2.10	6.4 . . 11.2	

β 1075. φ3 Hydrae.

R. A. 10h 30m 25s
Decl. — 15° 43′

1889.131	277°.4	3".00	6.0 . . 13.0	36
.134	275.8	3.07	6.0 . . 13.0	36
.151	278.1	3.02	6.0 . . 13.0	36
1889.14	277.1	3.03	6.0 . . 13.0	

β 1076. 55 Leonis.

R. A. 10h 49m 32s
Decl. + 1° 23′

1889.258	53°.4	1".14	6.0 . . 10.0	36
.285	48.5	0.84	5.5 . . 10.0	36
.288	47.2	0.98	6.0 . . 11.0	36
1889.28	49.7	0.99	5.8 . . 10.3	

β 1077. α Ursae Majoris.

R. A. 10h 56m 19s
Decl. + 62° 24′

1889.142	327°.0	0".96	2.0 . . 11.0	36
.151	325.9	0.83	. . 11.0	36
.227	326.3	0.77	. . 11.5	36
.247	325.1	1.08	. . 11.0	36
1889.19	326.1	0.91	2.0 . . 11.1	

A good example of a very unequal and moderately close pair. It is a difficult object to measure with the large telescope, except under very favorable conditions. It can hardly fail to prove to be a physical pair. The later measures show rapid motion. (See p. 73.)

β 1078. Crateris 79 = L. 22102.

R. A. 11h 33m 46s
Decl. — 13° 48′

1889.293	50°.8	8".19	6.0 . . 13.0	36
.296	49.4	8.17	6.5 . . 11.5	36
.302	49.1	8.30	6.5 . . 12.0	36
1889.30	49.8	8.22	6.3 . . 12.2	

β 1079. L. 22586.

R. A. 11h 54m 34s
Decl. — 21° 7′

1889.293	148°.0	11".59	6.0 . . 13.5	36
.296	148.0	11.87	6.0 . . 13.5	36
.302	147.7	11.62	6.5 . . 13.0	36
1889.30	147.9	11.69	6.2 . . 13.3	

β 1080. 17 Comae.

R. A. 12h 22m 55s
Decl. + 26° 35′

B and C.

1889.093	156°.8	2".01	. . 13.5	36
.107	157.8	1.59	. . 14.0	36
.131	155.9	1.78	. . 13.5	36
1889.11	156.8	1.79	. . 13.7	

A and B (= Σ 21 App. I.).

1889.093	250°.2	145".23	. .	36
.107	250.4	144.87	. .	36
1889.10	250.3	145.05	. .	

The new star is very minute, and, like many other stars of the same class given in this catalogue, will require a large aperture to satisfactorily measure it. The bright stars have remained substantially unchanged since the first measures:

1836.43	250°.7	145″.35	Σ
1877.77	250.4	145.38	Je

β 1081. 37 Comae.

R. A. 12h 54m 32s
Decl. + 31° 26′

1889.107	351°.8	5″.07	4.5 . . 14.0	36
.134	351.6	5.21	. . 13.5	36
.151	350.6	5.17	. . 14.0	36
1889.13	351.3	5.15	. . 13.8	

Very much like the last pair, except in distance.

β 1082. 78 Ursae Majoris.

R. A. 12h 55m 35s
Decl. + 57° 1′

1889.142	76°.7	1″.19	6.0 . . 9.5	36
.151	74.7	1.45	5.7 . . 10.5	36
.154	74.3	1.58	5.5 . . 10.0	36
.173	70.4	1.44	6.0 . . 9.0	12
.175	75.0	1.63	6.0 . . 9.5	12
.247	76.3	1.71	6.0 . . 9.0	36
1889.17	74.6	1.50	6.0 . . 9.6	

It is singular that so easy a pair should have been overlooked heretofore. A 6-inch aperture would probably show it.

β 1083. P. XII. 268.

R. A. 13h 0m 27s
Decl. + 29° 40′

B and C.

1889.093	236°.3	0″.47	11.0 . . 11.5	36
.107	237.4	0.47	11.5 . . 11.5	36
.131	238.1	0.53	12.0 . . 12.0	36
1889.11	237.3	0.49	11.5 . . 11.7	

A and BC (= H. 2638).

1889.093	220°.4	5″.97	6.5 . . .	36
.107	221.3	6.46	6.0 . . .	36
.131	217.9	6.26	7.0 . . .	36
1889.11	219.9	6.23	6.5 . . .	

The new pair is a very difficult object, and was therefore missed by me in measuring HERSCHEL'S companion with the Chicago 18½-inch. With good seeing it is a beautiful triple star with the large telescope. As one star the companion was seen with difficulty in 1874 with the 6-inch. HERSCHEL also noted a more distant star not measured above. The following are all the prior measures:

1831	209°.6	6″±	H	1 n	AB
1878.42	218.9	6.54	β	1 n	
1831	6.0	20±	H	1 n	AD
1878.42	7.2	40.28	β	1 n	

β 1084. W_1 XIII. 235.

R. A. 13h 15m 58s
Decl. — 4° 2′

1889.302	87°.9	2″.70	7.0 . . 12.0	36
.312	90.0	2.64	7.3 . . 13.0	36
.323	91.5	2.72	7.0 . . 13.0	36
1889.31	89.8	2.69	7.1 . . 12.7	

β 1085. Taylor 6986.

R. A. 14h 52m 34s
Decl. — 4° 30′

1889.296	18°.0	9″.19	6.0 . . 13.5	36
.302	20.6	9.52	6.0 . . 13.0	36
.312	20.0	9.31	6.0 . . 13.0	36
1889.30	19.5	9.34	6.0 . . 13.2	

β 1086. 47 Bootis.

R. A. 15h 1m 27s
Decl. + 43° 37′

1889.154	256°.4	6″.16	5½ . . 13.0	36
.227	257.1	6.01	. . 13.5	36
.244	256.2	5.93	. . 13.0	36
1889.21	256.6	6.03	5½ . . 13.2	

β 1087. τ Coronae.

R. A. 16h 4m 35s
Decl. + 36° 46′

1889.154	166°.8	3″.03	5½ . . 14.0	36
.227	171.2	3.22	. . 14.0	36
.244	169.4	3.07	. . 13.5	36
1889.21	169.1	3.11	5½ . . 13.8	

Similar to the last, but more difficult. The distance of the companion, if not connected with the primary, should increase about one third of a second annually, from the proper motion of the bright star, which is 0″.34 in the direction of 348°. (For later measures, see p. 87.)

β 1088. μ Draconis.

R. A. 17h 2m 51s
Decl. + 54° 38′

B and C.

1889.244	191°.4	12″.26	. . 13.5	36
.285	190.0	12.31	. . 12.5	36
.288	191.3	12.19	. . 13.0	36
1889.27	190.9	12.25	. . 13.0	

A and B (= Σ 2130).

1889.244	159°.7	2″.42	5½ . . 5½	36
.258	159.6	2.30	. .	36
.285	158.9	2.53	. .	36
.288	159.5	2.37	. .	36
1889.27	159.4	2.40	. .	

Future observations will show whether the new star belongs to the binary system. It is much easier than many of the faint companions given in this list. (See p. 92.)

β 1089. Y. 7220.

R. A. 17h 23m 22s
Decl. — 5° 49′

1888.600	4°.8	1″.20	7.0 . . 11.0	12
.636	7.2	0.91	6½ . . 11.0	12
.681	3.5	0.75	7.0 . . 11.0	12
1888.64	5.2	0.95	6.8 . . 11.0	

Found with the 12-inch.

β 1090. β Draconis.

R. A. 17h 27m 43s
Decl. + 52° 23′

1889.227	11°.8	4″.01	3.0 . . 15.0	36
.244	15.7	4.00	. . 15.0	36
.288	12.0	3.75	. . 15.0	36
.293	13.9	4.12	. . 14.5	36
1889.26	13.4	3.97	. . 14.0	

The companion is a very minute point, but well seen under proper conditions. If not a physical pair, the position-angle should increase from the proper motion of the bright star. (See p. 95.)

β 1091. L. 33592.

R. A. 18h 8m 35s
Decl. + 38° 34′

1888.782	40°.8	0″.53	8.5 . . . 8.5	12
.785	35.5	0.53	8.7 . . . 8.7	12
1888.78	38.1	0.53	8.6 . . . 8.6	

β 1092. Rad. 5777.

R. A. 22h 33m 3s
Decl. + 72° 15′

A and B (new).

1889.293	240°.9	0″.29	7.5 . . . 7.5	36
.312	233.3	0.36	7.5 . . . 7.5	36
1889.30	237.1	0.32	7.5 . . . 7.5	

AB and C.

1889.293	263°.9	29″.24	. . 12.5	36
.312	264.3	29.15	. . 12.0	36
.323	263.7	29.18	. . 12.0	36
1889.31	264.0	29.19	. . 12.2	

AB and D.

1889.293	137°.1	42″.05	. . . 7.5	36
.312	137.7	42.09	7.0 . . . 7.0	36
.323	137.5	42.37	7.5 . . . 7.0	36
1889.31	137.4	42.17	7.2 . . . 7.2	

This has long been known as a very wide double (= H_1 V. 94 = H_2 3133 = $O\Sigma$ App. 236). The large telescope shows the preceding bright star to be a close double. The fainter star, C, is not mentioned by H_1 and $O\Sigma$, but given in H_2 3133, and with an error of 90° in the position-angle of D. The place in H_1 V. 94 has an error of 7m R. A. and 29′ Decl. The bright stars are evidently fixed relatively. The following are all the prior measures:

1783.20	135°.2	41″.67	H_1	1 n
1875.13	137.6	42.18	Δ	3 n
1883.18	137.7	42.19	Franz	5 n

The following star is Rad. 5779.

SIXTEENTH CATALOGUE OF NEW DOUBLE STARS DISCOVERED AT THE LICK OBSERVATORY.

By S. W. Burnham.

The following double star observations have been made since the preparation of the last preceding list (A. N. 2929–30), and principally in the months of May, June, and July of the present year (1889). Since then the large telescope has been used the greater part of the time for other work. During the period mentioned sixty-two new pairs have been discovered and measured; and measures made of ninety-eight of the more interesting and difficult pairs from former catalogues; altogether comprising six hundred and twenty-eight separate measures. This work has been done with the 36-inch equatorial with the exception of the measures of a few southern stars, which could be more conveniently made with the smaller telescope.

The places of the stars are given, as heretofore, for 1880. The instrument used in each observation is given in the last column.

β 1093. L. 375.

R. A. $0^h\ 14^m\ 43^s$
Decl. $+\ 10^\circ\ 19'$

	°	″		
1889.630	55.8	0.37	7.0 . . . 8.0	36
.633	57.8	0.42	7.5 . . . 8.0	36
.687	49.2	0.39	7.5 . . . 8.5	36
1889.65	54.3	0.39	7.3 . . . 8.2	

The following of three bright stars.

β 1094. L. 655.

R. A. $0^h\ 23^m\ 35^s$
Decl. $+\ 59^\circ\ 19'$

	°	″		
1889.526	242.8	0.60	5.0 . . 9.0	36
.534	244.3	0.81	6.0 . . 9.5	36
.537	246.6	0.70	6.0 . . 10.0	36
1889.53	244.6	0.70	5.7 . . 9.5	

β 1095. 28 Andromedae.

R. A. $0^h\ 23^m\ 47^s$
Decl. $+\ 29^\circ\ 5'$

	″	°		
1889.509	0.4	2.37	5.5 . . 13.0	36
.512	0.1	2.33	5.5 . . 14.0	36
.515	359.7	2.55	5.5 . . 13.0	36
1889.51	0.1	2.42	5.5 . . 13.3	

β 1096. O. Arg. N. 534.

R. A. $0^h\ 29^m\ 46^s$
Decl. $+\ 57^\circ\ 51'$

A and B.

	°	″		
1889.594	265.2	0.19	9.5 . . . 9.6	36
.671	267.9	. . .	. . .	36
.673	269.9	0.25	9.5 . . . 9.5	36
1889.61	267.7	0.22	9.5 . . . 9.5	

AB and C.

1889.594	61°.7	33″.29	...8.6	36
.597	61.6	33.49	...9.0	36
.608	62.0	33.36	...9.0	36
1889.60	61.8	33.38	...8.9	

β 1097. Radcl. 159.

R. A. $0^h\ 30^m\ 30^s$
Decl. $+\ 57°\ 21'$

1889.594	72°.1	0″.56	8.0...8.0	36
.597	69.9	0.71	8.5...8.5	36
.608	71.5	0.52	8.2...8.2	36
.611	72.8	0.50	8.5...8.5	36
1889.60	71.6	0.57	8.4...8.4	

The magnitude in Radcl. is 7.4, and in D.M. 7.0.

β 1098. υ¹ Cassiopeiae.

R. A. $0^h\ 47^m\ 53^s$
Decl. $+\ 58°\ 19'$

1889.594	75°.4	12″.77	5.0..13.5	36
.608	74.9	12.61	6.0..13.5	36
.611	75.3	12.99	6.0..13.5	36
1889.60	75.2	12.79	6.0..13.5	

β 1099. B.A.C. 255.

R. A. $0^h\ 49^m\ 33^s$
Decl. $+\ 59°\ 43'$

1889.534	270°.0	0″.13	6.0...6.5	36
.589	276.0	0.16	6.0...7.0	36
.594	264.5	0.16	6.3...7.0	36
1889.57	270.2	0.15	6.1...6.8	

This very close and difficult pair is 21′ s of *γ Cassiopeiae*. It is GROOMBRIDGE 184. (See p. 22.)

β 1100. L. 2155.

R. A. $1^h\ 7^m\ 5^s$
Decl. $+60°\ 18'$

1889.526	45°.3	0″.51	7.5...7.5	36
.534	45.4	0.47	7.3...7.3	36
.553	40.2	0.45	7.3...7.3	36
1889.54	43.6	0.48	7.4...7.4	

β 1101. ψ Cassiopeiae.

R. A. $1^h\ 17^m\ 27^s$
Decl. $+\ 67°\ 30'$

A and B.

1889.515	41°.3	3″.40	4.5..13.5	36
.523	40.9	3.07	4.5..13.5	36
.526	41.9	3.07	..13.0	36
.534	40.6	3.24	..14.0	36
1889.52	41.2	3.19	..13.5	

A and C (= Σ 117).

1889.515	107°.3	28″.21	..	36
.523	107.9	27.90	..	36
.526	107.2	27.84	..	36
.534	107.4	28.10	..	36
1889.52	107.4	28.01	..	

C and D (= Σ 117).

1889.515	255°.6	2″.83	9.5.. 9.7	36
.523	255.0	2.87	9.5.. 9.7	36
.526	254.5	2.87	9.8..10.0	36
.534	253.9	2.88	9.5.. 9.7	36
1889.52	254.7	2.86	9.6.. 9.8	

The new star is not difficult. (See p. 25.)

β 1102. O. Arg. N. 1510.

R. A. $1^h\ 19^m\ 38^s$
Decl. $+\ 59°\ 40'$

B and C.

1889.583	335°.6	0″.93	10.5..10.5	12
.586	335.3	0.82	10.5..10.5	36
.589	338.0	0.77	10.0..10.0	36
1889.58	336.3	0.84	10.3..10.3	

A and BC.

1889.583	265°.3	60″.30	8.5..	12
.586	265.4	60.26	8.5..	36
.589	265.6	60.31	8.5..	36
1889.58	265.4	60.29	8.5..	

The principal star is Radcl. 430, and is $1^m\ 41^s$ f δ *Cassiopeiae* and 2′ 58″ n.

β 1103. 44 Cassiopeiae.

R. A. $1^h\ 35^m\ 12^s$
Decl. $+\ 59^\circ\ 56'$

1889.526	7.8	1.63	6.5 . . 12.5	36
.534	1.4	1.81	6.0 . . 13.5	36
.553	2.2	1.75	6.0 . . 12.0	36
1889.54	3.8	1.73	6.2 . . 12.5	

β 1104. Groombridge 370.

R. A. $1^h\ 35^m\ 51^s$
Decl. $+\ 52^\circ\ 17'$

1889.589	199.1	2.97	7.0 . . 12.0	36
.611	195.2	2.82	7.3 . . 12.0	36
.616	197.4	2.80	7.3 . . 11.5	36
1889.60	197.2	2.86	7.2 . . 11.8	

Found with the 12-inch.

β 1105. Pleiades.

R. A. $3^h\ 41^m\ 26^s$
Decl. $+\ 23^\circ\ 49'$

1889.589	60.2	0.34	9.5 . . 10.0	36
.594	58.4	0.33	8.8 . . 10.0	36
.689	54.6	0.31	9.5 . . 11.0	36
1889.62	57.7	0.33	9.3 . . 10.3	

Rather difficult pair $1^m\ 4^s$ f and 4'.3 n of *Alcyone*. It is D.M. (23°) 554.

β 1106. Pleiades.

R. A. $3^h\ 42^m\ 58^s$
Decl. $+\ 23^\circ\ 51'$

1889.594	51.7	0.40	11.5 . . 11.5	36

Difficult pair; too faint for the D.M. Place from the Paris map of the *Pleiades*. It is 55^s f and 4'.6 n of 28 *Tauri* (Pleione).

β 1107. O. Arg. S. 12884.

R. A. $13^h\ 20^m\ 36^s$
Decl. $-\ 21^\circ\ 44'$

1889.351	130.5	1.36	8.5 . . . 8.5	12
.373	135.9	. . .	8.6 . . . 8.6	12
.375	135.8	. . .	. . .	12
.378	132.8	1.18	8.5 . . . 8.5	36
.381	134.0	0.98	. . .	36
1889.37	133.8	1.17	8.5 . . . 8.5	

β 1108. B.A.C. 4631.

R. A. $13^h\ 46^m\ 32^s$
Decl. $-\ 35^\circ\ 4'$

A and B.

1889.373	81.3	1.48	6.0 . . . 6.0	12
.383	86.9	1.14	6.0 . . . 6.0	36
.386	83.9	1.21	. . .	36
1889.38	84.0	1.28	6.0 . . . 6.0	

A and D (= H_1 V. 24).

1889.383	359.1	65.25	. . . 8.5	36
.386	359.0	65.18	. . .	36
1889.38	359.0	65.21	. . .	

A and C.

1889.386	168.2	27.52	. . 12.0	36

β 1109. D.M. (5°) 2846.

R. A. $14^h\ 3^m\ 18^s$
Decl. $+\ 5^\circ\ 14'$

A and B.

1889.381	321.3	1.83	. . 13.5	36
.386	322.6	1.62	. . 14.0	36
.397	321.8	1.88	. . 13.5	36
1889.39	321.9	1.78	. . 13.7	

A and C.

1889.381	356.0	53.02	9.0 . . . 9.0	36
.386	356.1	53.02	9.0 . . . 9.0	36
.397	356.8	53.08	9.0 . . . 9.0	36
1889.39	356.3	53.04	9.0 . . . 9.0	

β 1110. Taylor 6665.

R. A. $14^h\ 12^m\ 29^s$
Decl. $-\ 36^\circ\ 18'$

1889.389	127.7	3.82	6.5 . . 12.0	12
.392	131.0	4.00	7.5 . . 12.5	12
.408	133.3	4.02	7.0 . . 12.5	12
1889.39	130.7	3.95	7.0 . . 12.3	

β 1111. P. XIV. 69.

R. A. $14^h\ 17^m\ 29^s$
Decl. $+\ 9^\circ\ 0'$

B and C.

1889.397	136.8	0.21	8.5 . . . 8.5	36
.400	133.4	0.17	8.3 . . . 8.3	36
.403	135.8	0.20	8.5 . . . 8.5	36
1889.40	135.3	0.19	8.4 . . . 8.4	

A and BC (= Σ 1835).

1889.397	189°.8	6″.34	5.0 . . .	36
.400	189.4	6.39	5.5 . . .	36
.403	189.5	6.36	5.6 . . .	36
1889.40	189.6	6.36	5.4 . . .	

There seems to be but little if any change in the stars:

1832.08	186°.5	6″.06	Σ

(For later measures of BC, see p. 81.)

β 1112. Lacaille 5983.

R. A. 14h 26m 3s
Decl. — 30° 11′

1889.392	8°.2	2″.52	6.3 . . 12.5	12
.400	8.4	2.64	6.0 . . 12.0	36
.403	7.9	2.37	6.2 . . 11.0	36
.430	5.2	2.19	6.5 . . 10.5	12
.436	9.6	2.51	6.0 . . 10.0	36
.444	6.1	2.40	7.0 . . 10.8	12
1889.41	7.6	2.44	6.3 . . 11.1	

β 1113. B.A.C. 4886.

R. A. 14h 41m 21s
Decl. + 2° 32′

1889.397	137°.1	4″.63	6.0 . . 11.5	36
.400	136.7	4.42	6.5 . . 12.5	36
.403	137.6	4.58	6.0 . . 11.5	36
1889.40	137.1	4.54	6.2 . . 11.8	

Magnitude in D.M. 7.7.

β 1114. B.A.C. 5090.

R. A. 15h 21m 42s
Decl. — 28° 27′

A and B.

1889.373	319°.7	0″.73	7.0 . . . 7.5	12
.383	325.8	0.52	7.0 . . . 7.3	36
.386	331.5	0.69	7.0 . . . 7.0	36
1889.38	325.7	0.65	7.0 . . . 7.3	

AB and C (= H. 4774).

1889.373	5°.8	9″.28	. . 11.0	12
.383	6.2	9.27	. . 9.0	36
.386	5.5	9.09	. . 9.5	36
1889.38	5.8	9.21	. . 9.8	

There seems to be no change in the angle of the wide pair, as HERSCHEL found 8°.5 in 1834.

β 1115. L. 29840.

R. A. 16h 18m 3s
Decl. — 23° 11′

1889.386	23°.3	0″.89	8.0 . . 9.0	36
.389	25.4	0.93	8.0 . . 9.0	12
.392	26.3	0.81	8.3 . . 8.8	12
.397	30.3	0.98	8.0 . . 10.0	36
1889.39	26.3	0.90	8.1 . . 9.2	

This star is a distant companion to ρ *Ophiuchi*, 156″.43 distant, in the direction of 253°.0. (See p. 88.)

β 1116. B.A.C. 5600.

R. A. 16h 36m 51s
Decl. — 27° 14′

1889.389	358°.6	1″.62	7.0 . . 12.0	12
.392	356.3	1.75	6.7 . . 12.0	12
.400	3.2	1.98	6.5 . . 11.0	36
1889.39	359.4	1.78	6.7 . . 11.7	

β 1117. 24 Ophiuchi.

R. A. 16h 49m 34s
Decl. — 22° 57′

1889.389	262°.4	0″.88	6.5 . . . 6.7	12
.392	260.2	0.72	6.5 . . . 6.6	12
.397	268.9	0.59	6.3 . . . 6.3	36
.403	265.5	0.60	6.5 . . . 6.5	36
1889.39	264.2	0.70	6.4 . . . 6.5	

(For later measures, see p. 90.)

β 1118. η Ophiuchi.

R. A. 17h 3m 30s
Decl. — 15° 34′

1889.383	270°.6	0″.31	4.0 . . . 4.5	36
.392	277.8	0.35	3.0 . . . 4.0	12
.397	276.9	0.38	3.5 . . . 3.7	36
.400	273.6	0.37	3.0 . . . 3.5	36
1889.39	274.7	0.35	3.4 . . . 3.9	

As the proper motion of this star is 0″.1 (in the direction of 2°.5), it is evident that this is a physical pair. (See p. 92.)

β 1119. B.A.C. 5820.

R. A. $17^h\ 9^m\ 40^s$
Decl. $-30°\ 2'$

1889.392	350°.1	0".74	7.5 . . . 8.0	12
.403	358.3	0.82	6.5 . . . 6.7	36
.422	359.0	0.69	7.0 . . . 8.0	36
1889.40	355.8	0.75	7.0 . . . 7.6	

Discovered with th 12-inch.

β 1120. B.A.C. 5896.

R. A. $17^h\ 21^m\ 14^s$
Decl. $-25°\ 24'$

1888.636	99°.8	0".98	7.0 . . . 7.0	12
1889.392	98.4	0.91	7.0 . . . 7.0	12
.400	101.9	0.91	7.0 . . . 7.0	36
1889.14	100.0	0.93	7.0 . . . 7.0	

Discovered with the 12-inch.

β 1121. D.M. (12°) 3264.

R. A. $17^h\ 31^m\ 52^s$
Decl. $+12°\ 37'$

1888.636	241°.5	0".73	. . .	12
1889.392	240.5	0.73	8.5 . . . 9.0	12
.403	239.4	0.68	8.5 . . . 9.0	36
1889.14	240.1	0.71	8.5 . . . 9.0	

This is $2^m\ 30^s$ f. *α Ophiuchi*, and 2'.5 s.

β 1122.

R. A. $17^h\ 44^m\ 38^s$
Decl. $-28°\ 27'$

B and C.

1889.389	171°.2	1".24	10.5 . . 11.0	12
.392	176.8	1.27	10.8 . . 11.3	12
.397	177.7	1.42	10.0 . . 10.5	36
1889.39	175.2	1.31	10.4 . . 10.9	

A and BC (= Howe).

1889.389	10°.6	6".59	. . . 8.5	12
.392	7.4	6.59	. . . 9.0	12
.397	10.9	6.20	. . . 8.7	36
1889.39	9.6	6.46	. . . 8.7	

The principal star is No. 24248 of the Argentine Catalogue. The wide pair was discovered by Howe at Cincinnati:

1880.44	8°.7	6".54	Cin	2 n

β 1123.

R. A. $17^h\ 45^m\ 20^s$
Decl. $-34°\ 42'$

1889.465	214°.1	0".51	7.5 . . . 8.0	12
.468	214.8	0.63	7.0 . . . 7.5	12
.473	203.9	0.66	7.5 . . . 8.0	12
.508	218.2	0.54	7.5 . . . 7.7	12
1889.48	212.8	0.58	7.4 . . . 7.8	

In a large cluster. It is No. 24262 of the Argentine Catalogue.

β 1124. 67 Ophiuchi.

R. A. $17^h\ 54^m\ 38^s$
Decl. $+2°\ 56'$

A and B.

1889.383	194°.4	6".57	5.0 . . 14.0	36
.397	197.6	6.96	. . 15.0	36
.400	194.9	6.83	. . 15.5	36
1889.39	195.6	6.79	5.0 . . 14.8	

C and D (= β 634).

1889.397	130°.6	8".47	8.0 . . 11.0	36
.400	128.6	8.32	8.7 . . 12.0	36
1889.40	129.6	8.40	8.3 . . 11.5	

A and C (= Sh. 255).

1889.397	143°.6	54".51	. .	36
.400	143.6	54.57	. .	36
1889.40	143.6	54.54	. .	

Very little change in the wide pair:

1878.57	129°.2	8".46	β	1 n
1878.57	143.0	54.70	β	1 n

β 1125. 68 Ophiuchi.

R. A. $17^h\ 55^m\ 40^s$
Decl. $+1°\ 19'$

1889.383	18°.0	0".83	5.0 . . 10.0	36
.389	10.5	1.18	5.0 . . 10.0	12
.392	13.1	0.93	5.5 . . 9.5	12
.397	18.0	1.18	5.0 . . 10.0	36
.400	14.8	0.93	5.0 . . 10.0	36
1889.39	14.9	1.01	5.1 . . 9.9	

β 1126. Yar. 7599.

R. A. $17^h\ 56^m\ 54^s$
Decl. $-\ 24^\circ\ 15'$

A and B.

1889.397	59°.4	0".62	8.5 . . 9.0	36
.400	51.1	0.67	9.0 . . 10.0	36
.403	54.4	0.63	9.0 . . 10.0	36
.422	57.5	0.59	8.5 . . 8.8	36
1889.40	55.6	0.63	8.7 . . 9.5	

A and C (= H. 5009).

1889.397	22.9	3.98	. . 9.5	36
.400	24.6	4.13	. . 10.5	36
.403	23.6	4.14	. . 9.5	36
.422	22.1	3.97	. . 9.0	36
1889.40	23.3	4.05	. . 9.6	

In *Messier* 8. The wide pair unchanged:

1837.70	20°.8	2" ±	H	1 n
1880.58	19.9	3.86	Cin	1 n

β 1127. Groombridge 2500.

R. A. $17^h\ 58^m\ 59^s$
Decl. $+\ 44^\circ\ 13'$

1889.523	143°.7	0".67	8.0 . . 10.0	12
.526	149.2	0.83	7.5 . . 9.0	12
.534	141.2	0.89	7.8 . . 10.0	36
1889.53	144.7	0.80	7.8 . . 9.7	

The magnitude in D.M. is 6.5, and in Radcl. 7.2. Discovered with the 12-inch.

β 1128. B.A.C. 6285.

R. A. $18^h\ 23^m\ 12^s$
Decl. $-\ 33^\circ\ 4'$

1889.392	198°.7	3".27	6.0 . . 12.5	12
.447	198.4	3.14	6.2 . . 11.0	12
.458	198.6	3.11	6.0 . . 11.0	12
1889.42	198.6	3.17	6.1 . . 11.5	

This pair was discovered by HOWE, at Cincinnati. At the time of the first publication of this catalogue, it was supposed to be new.

β 1129. Groombridge 2829.

R. A. $19^h\ 18^m\ 51^s$
Decl. $+\ 52^\circ\ 9'$

1889.476	343°.6	0".33	6.5 . . . 6.5	36
.482	343.5	0.39	6.0 . . . 6.0	36
.499	345.7	0.31	6.5 . . . 6.5	36
1889.48	344.3	0.34	6.3 . . . 6.3	

The magnitude in D.M. is 7.1.

β 1130. 9 Vulpeculae.

R. A. $19^h\ 29^m\ 18^s$
Decl. $+\ 19^\circ\ 23'$

1889.422	32°.2	9".67	5.5 . . 13.5	36
.433	31.5	9.58	5.5 . . 14.0	36
.436	30.3	9.35	. . 15.0	36
1889.43	31.3	9.53	5.5 . . 14.0	

β 1131. θ Cygni.

R. A. $19^h\ 33^m\ 13^s$
Decl. $+\ 49^\circ\ 56'$

1889.323	45°.2	3".59	5.0 . . 14.0	36
.383	40.7	3.57	. . 14.0	36
.403	45.9	3.70	. . 15.0	36
1889.37	43.9	3.62	5.0 . . 14.3	

The proper motion of this star is 0".24 in the direction of 352°.4, so that in four years, if this motion is not common to both stars, the distance of the companion will be about 3".1, and the angle 58°. (See p. 112.)

β 1132. W_2 XIX. 1204.

R. A. $19^h\ 38^m\ 11^s$
Decl. $+\ 26^\circ\ 39'$

1889.553	226°.5	0".48	8.0 . . . 9.0	36
.556	226.5	0.53	8.5 . . . 8.5	36
.559	229.0	0.46	8.5 . . . 8.7	36
1889.56	227.3	0.49	8.3 . . . 8.7	

β 1133. L. 38224.

R. A. $19^h\ 54^m\ 56^s$
Decl. $+\ 31^\circ\ 30'$

1889.553	340°.2	0".84	7.0 . . 9.0	36
.556	339.0	0.88	6.8 . . 9.5	36
.559	336.5	0.89	6.7 . . 10.0	36
1889.56	338.6	0.87	6.8 . . 9.5	

β 1134. D.M. (63°) 1618.

R. A. 20h 19m 29s
Decl. + 63° 36′

1889.476	81°.7	4″.24	5.5 . . 13.0	36
.482	79.7	4.38	6.0 . . 12.0	36
.499	80.9	4.35	6.0 . . 13.0	36
1889.48	80.8	4.32	5.8 . . 12.7	

This star is RÜMKER 8289, and No. 11312 of the A. G. Catalogue. It is singular that a naked-eye star should have been overlooked by so many meridian observers. The magnitude in the D.M. is 5.9, in RÜMKER 5.9, and in A. G. C. 5.5.

β 1135. L. 39561.

R. A. 20h 25m 10s
Decl. + 45° 20′

1889.523	339°.5	1″.42	8.5 . . 10.7	12
.526	338.3	1.87	8.3 . . 10.8	12
.531	337.9	1.44	8.3 . . 10.3	36
.534	337.7	1.41	8.0 . . 11.0	36
1889.53	338.3	1.53	8.3 . . 10.7	

Discovered with the 12-inch.

β 1136. L. 39698.

R. A. 20h 28m 6s
Decl. + 49° 8′

1889.534	204°.9	0″.33	8.0 . . 10.0	36
.537	207.4	0.40	8.0 . . 10.0	36
.556	207.5	0.32	8.4 . . 9.0	36
1889.54	206.6	0.35	8.1 . . 9.7	

Discovered with the 12-inch.

β 1137. B.A.C. 7278.

R. A. 20h 52m 36s
Decl. + 50° 16′

1889.436	344°.0	6″.99	6.0 . . 13.5	36
.438	343.3	6.98	6.0 . . 14.0	36
.460	345.7	6.66	6.0 . . 13.5	36
1889.44	344.3	6.88	6.0 . . 13.7	

β 1138. L. 40856.

R. A. 20h 58m 34s
Decl. + 45° 22′

1889.436	187°.1	0″.29	7.5 . . . 9.5	36
.438	193.1	0.27	7.0 . . . 8.0	36
.460	186.0	0.30	7.0 . . . 8.0	36
1889.44	188.7	0.29	7.2 . . . 8.5	

The following of two stars. In D.M. 6.7-m.

β 1139. Radcl. 5088.

R. A. 20h 58m 39s
Decl. + 56° 36′

1889.323	139°.1	1″.93	6.0 . . 12.5	36
.383	136.3	1.76	6.0 . . 13.0	36
.403	140.4	1.89	6.0 . . 12.0	36
1889.37	138.6	1.86	6.0 . . 12.5	

β 1140. Radcl. 5183.

R. A. 21h 14m 1s
Decl. + 58° 6′

1889.573	276°.0	4″.04	6.5 . . 13.0	36
.578	276.3	3.95	6.7 . . 12.0	36
.589	277.2	3.69	6.8 . . 12.0	36
1889.58	276.5	3.89	6.7 . . 12.3	

β 1141. O. Arg. N. 22270.

R. A. 21h 22m 7s
Decl. + 57° 43′

1889.573	165°.5	2″.69	7.5 . . 13.5	36
.578	164.8	2.67	7.5 . . 13.0	36
.589	167.4	2.79	8.0 . . 13.0	36
1889.58	165.9	2.72	7.7 . . 13.2	

β 1142. D.M. (56°) 2579.

R. A. 21h 25m 6s
Decl. + 56° 33′

1889.578	355°.0	0″.46	8.7 . . . 8.7	36
.589	352.5	0.41	8.8 . . . 8.8	36
.592	354.2	0.35	8.7 . . . 8.7	36
1889.59	353.9	0.41	8.7 . . . 8.7	

β 1143. P. XXI. 248.

R. A. 21h 35m 14s
Decl. + 56° 57′

A and B.

1889.611	325°.0	1″.52	6.0 . . 14.0	36
.616	322.0	1.59	. . 13.5	36
.630	323.6	1.53	. . 13.5	36
1889.62	323.5	1.55	6.0 . . 13.7	

A and C (= Σ 2816).

1889.611	120°.2	11″.93	. . . 7.5	36
.613	120.0	11.76	. . . 7.5	36
.616	121.2	11.88	. . . 7.0	36
1889.61	120.4	11.86	. . . 7.3	

A and D (= Σ 2816).

1889.611	339°.6	19″.92	. . . 7.5	36
.613	339.8	19.98	. . . 7.5	36
.616	339.1	19.91	. . . 7.0	36
1889.61	339.5	19.94	. . . 7.3	

No change in the Σ stars:

1832.94	120°.1	11″.66	Σ
1832.94	339.7	19.96	Σ

β 1144. η Pegasi.

R. A. 22h 37m 23s
Decl. + 29° 36′

B and C.

1889.526	83°.2	0″.33	10.0 . . 10.0	36
.534	85.5	0.26	10.0 . . 10.0	36
.537	82.9	0.27	10.0 . . 10.0	36
.540	81.7	0.31	10.5 . . 10.5	36
1889.53	83.3	0.29	10.1 . . 10.1	

A and BC (= H_1 VI. 21).

1889.526	339°.0	90″.27	3.0 . . .	36
.534	339.2	90.43	. . .	36
.537	339.0	90.39	. . .	36
.540	338.9	90.44	. . .	36
1889.53	339.0	90.38	. . .	

There are no measures of the distant star in H_1; but from South's observations it would appear unchanged:

1824.85	338°.9	89″.82	S	2 n

β 1145. O. Arg. N. 24690.

R. A. 22h 42m 45s
Decl. + 57° 55′

A and B.

1889.578	154°.2	0″.98	8.0 . . 10.5	36
.589	151.4	0.97	8.0 . . 11.5	36
.611	153.5	1.14	8.5 . . 11.0	36
1889.59	153.0	1.03	8.2 . . 11.0	

A and C.

1889.578	179°.4	21″.98	. . . 9.3	36
.589	179.6	22.01	. . . 9.8	36
.611	179.5	21.98	. . . 9.5	36
1889.59	179.5	21.99	. . . 9.5	

β 1146. W_2 XXII. 971.

R. A. 22h 42m 48s
Decl. + 30° 28′

1889.537	336°.2	0″.25	7.0 . . . 8.5	36
.540	336.6	0.19	7.5 . . . 8.5	36
.570	333.2	0.24	7.0 . . . 7.5	36
1889.55	335.3	0.23	7.2 . . . 8.2	

β 1147. 2 Andromedae.

R. A. 22h 57m 5s
Decl. + 42° 7′

1889.534	317°.3	0″.28	5.0 . . . 8.5	36
.537	317.6	0.29	5.0 . . . 8.5	36
.556	318.5	0.27	5.0 . . . 9.0	36
1889.54	317.8	0.28	5.0 . . . 8.7	

Suspected with the 12-inch, and verified and measured with the large telescope. (See p. 135.)

β 1148. Groombridge 4070.

R. A. 23h 22m 12s
Decl. + 64° 58′

1889.592	71°.0	2″.06	6.7 . . 13.0	36
.594	76.4	2.20	7.0 . . 13.0	36
.611	74.3	2.13	7.5 . . 13.0	36
1889.60	73.9	2.13	7.1 . . 13.0	

The magnitude in D.M. is 6.5.

β 1149. D.M. (57°) 2746.

R. A. 23h 24m 11s
Decl. + 58° 1′

1889.578	311.0	0.50	9.5 . . 10.0	36
.586	305.4	0.53	9.3 . . . 9.8	36
.589	311.0	0.52	9.5 . . 9.7	36
1889.58	309.1	0.52	9.4 . . 9.8	

This star is in the field with OΣ 496; distance, 231″.07, in the direction of 207°.6.

β 1150. O. Arg. N. 25672.

R. A. 23h 24m 46s
Decl. + 64° 24′

1889.594	46.2	0.63	8.5 . . . 8.5	36
.597	40.7	0.57	9.0 . . . 9.5	36
.608	45.0	0.62	8.7 . . . 9.0	36
1889.60	44.0	0.61	8.7 . . . 9.0	

β 1151.

R. A. 23h 25m 6s
Decl. + 57° 43′

1889.578	295.2	0.62	9.5 . . . 9.7	36
.586	291.7	0.72	9.7 . . . 9.7	36
.589	294.2	0.57	9.8 . . . 9.8	36
1889.59	293.7	0.64	9.7 . . . 9.7	

This is too small a star to be included in the D.M. It is near Σ 3022. The following measures give its place from that pair:

Σ 3022 and new pair.

1889.578	189.7	116.57	. . .	36
.586	189.8	117.05	. . .	36
.589	189.7	117.03	. . .	36
1889.58	189.7	116.88	. . .	

β 1152. Groombridge 4142.

R. A. 23h 42m 17s
Decl. + 63° 9′

B and C.

1889.594	99.1	0.69	9.0 . . . 9.0	36
.597	103.2	0.66	9.0 . . . 9.0	36
.608	105.8	0.56	9.5 . . . 9.6	36
1889.60	102.4	0.64	9.2 . . . 9.2	

A and BC.

1889.594	136.0	74.31	. . . 7.5	36
.597	136.8	74.32	. . . 7.5	36
.608	136.1	74.20	. . . 7.5	36
1889.60	136.3	74.28	. . . 7.5	

β 1153.

R. A. 23h 46m 45s
Decl. + 60° 2′

A and B.

1889.673	321.2	0.40	9.5 . . 9.6	36
.687	316.0	0.45	. .	36
.689	322.1	0.40	9.7 . . 10.0	36
.692	314.9	0.48	10.0 . . 10.2	36
1889.68	318.5	0.43	9.7 . . 9.9	

AB and C.

1889.673	339.8	13.80	. . 9.8	36
.687	339.1	13.61	. .	36
.689	339.5	13.74	. . 10.5	36
1889.68	339.5	13.72	. . 10.1	

OΣ 511 and β 1153.

1889.687	246.0	176.48	. .	36
.689	246.0	176.55	. .	36
1889.69	246.0	176.51	. .	

In the field and preceding OΣ 511. The new pair is not in the D.M.

β 1154. D.M. (73°) 1068.

R. A. 23h 53m 12s
Decl. + 74° 10′

1889.512	314.7	1.12	8.0 . . . 8.2	12
.515	308.5	0.88	8.0 . . . 8.0	36
.518	307.0	0.93	8.0 . . . 8.2	36
1889.51	310.1	0.98	8.0 . . . 8.2	

Discovered with the 12-inch.

SEVENTEENTH CATALOGUE OF NEW DOUBLE STARS DISCOVERED AT THE LICK OBSERVATORY.

By S. W. Burnham.

The double star observations which follow, represent the principal portion of my work in this direction during the year 1890. Substantially all the work was done between April 1st and December 1st. On two nights of the week the large telescope has been used by me for micrometrical work when the weather on these nights has been favorable. A few measures have been made at other times with the 12-inch, but nearly all of the measures given here were made with the great telescope. The character of the objects selected for re-measurement was such that it was very desirable to attain all the accuracy possible by employing the more powerful instrument, and many of the stars could not be seen at all with the other. Most of the new stars found from time to time, including some of those which were discovered with the 12-inch, are much too close or unequal for satisfactory measurement with that instrument. The large telescope leaves nothing to be desired in this or any other class of micrometrical work. The definition of the object-glass, like that of most, if not all, of the telescopes made by Clark & Sons, is practically perfect with proper atmospheric conditions. The driving clock, by Warner & Swasey, has worked perfectly from first to last, without a single failure at any time, and is probably as fine a piece of mechanism of its kind as can be found anywhere.

The micrometer, by Fauth & Co., is most complete and satisfactory, and with the method employed for illuminating the wires, any object, however faint and difficult, can be measured. I am satisfied that there is no plan in use for illuminating the lines and controlling their brightness so unobjectionable in every respect as the one applied to this micrometer. A description and cut of the 12-inch micrometer, of which the large micrometer is a copy in all essential details, will be found in the introduction to my observations with the Chicago refractor in 1879–80 (*Memoirs of the R. A. S.*, XLVII., 171). The light is furnished by a small oil lamp as in the original device, and after some experiments with electric lighting, I am convinced that the oil lamp is far less trouble to use, and superior to the other method. There is nothing to get out of order, and the sole attention required is to occasionally fill the lamp with sperm oil, to which has been added about twenty per cent of kerosene.

The observing chair, with its simple sliding seat, designed by Professor HOUGH (*Monthly Notices*, March, 1881), has proved as serviceable here as elsewhere. It is certainly the best arrangement ever invented for use with either a large or a small telescope. It would be almost impossible to get along without it in doing this class of work with the large equatorial. When the driving-clock is attached, the movement of the eye-piece, which is nearly thirty feet from the center of motion, is so rapid, that it is necessary, every two or three minutes in some positions of the instrument, to raise or lower the seat in order to have the observer in a comfortable and convenient position in using the micrometer, and any but a simple device of this kind would be impracticable.

The 12-inch refractor is provided with similar accessories, which work in an equally satisfactory manner. It only remains to be said in this connection that any errors or shortcomings which may appear in the observations following, must be charged entirely to the observer, and not to the instruments with which the work was done.

The methods of observation are the same as heretofore. With few exceptions each star has been measured on at least three nights. The angles are usually from four or five settings of the wires, with three readings for distance on each side of the fixed wire. There appears to be nothing gained by taking any more readings on a single night.

In the selection of stars for re-observation, I have endeavored to take such pairs as could not, or would not, be observed elsewhere, leaving the old binaries and other easy pairs to be looked after by other observers. Nearly all of the most interesting physical systems, and especially those in rapid motion, are difficult objects to measure, and many of them beyond the reach of any but the most powerful telescopes. These are largely of recent discovery, and of which few measures have been made. Stars of this class have been kept on the working-list, and as far as possible will be measured every year. Another class of stars, principally from my own catalogues, with every indication, so far as the distance is concerned, of physical relation, have been measured previous to this time only once; and these have received some attention, with the result of finding some in apparently rapid motion. I have also looked up a good many stars of doubtful duplicity, and the results, negative and otherwise, will be found in the measures. As a rule observations of this kind, when the stars were not seen double, are only noted when the conditions were sufficiently favorable to warrant the positive statements made regarding the probable duplicity. Negative results with the large telescope, as with any other, are of little value except when obtained on first-class nights; and, therefore, when from the lack of good definition, or from other unfavorable conditions, it was doubtful whether a slight elongation could be seen, I have made no note of the observation. The measures and discoveries will show how far it is probable that any pair seen elsewhere would be missed here.

The catalogue of new stars contains 70 pairs, of which number 39 have distances less than 1″, with an average distance of 0″.45. Of the latter number 25 are less than 0″.5, the average distance being 0″.33. The new stars cover a wide range of magnitudes, some of the closest of them being near the limits of the Durchmusterung.

The following naked-eye stars are inclued in the list of new stars:

B.A.C. 230	34 *Persei*	36 *Geminorum*
Ceti 199	B.A.C. 1142	65 *Geminorum*
95 *Piscium*	*Tauri* 248	τ *Herculis*
χ *Persei*	5 *Camelop.*	24 *Aquarii*
48 *Cephei* (H)	ν *Geminorum*	ψ^1 *Aquarii*

The following pairs previously known have been found to be more closely double:

H 1981	OΣ (App.) 77	OΣ 425
S 409	Σ 2476	Σ 12, App. II
Σ 809		

These are all sufficiently difficult to account for their having been overlooked heretofore.

While no rule, unless it is a very general one, can be laid down for the limit of distance in noting new pairs, it is certainly true that so far as stars are concerned which will probably prove to be binary, it is hardly worth while saving any where the distances of equal stars are not decidedly under 2″. Nearly all the pairs in rapid motion are less than 1″. A new class of doubles, unknown in the older catalogues, consisting of bright naked-eye stars, with very small companions at distances varying from 0″.8 to 2″, has been added within a few years. Down to the commencement of work with the 36-inch telescope, nearly all the examples of this class were discovered with the Chicago 18½-inch. A few were found by the CLARKS, and some of these have already been shown to be of the most interesting character, for instance τ *Cygni*, 99 *Herculis*, 95 *Ceti*, etc. It is not improbable some very short periods will be found in this class of stars. Some interesting systems may be expected when the stars of this class discovered here are re-measured in the future.

If my purpose had been to make an imposing catalogue of discoveries by finding as many new pairs as possible without reference to their character, the number in my lists down to this time could easily have been made many times larger, without exceeding the STRUVE limits of magnitudes and distance; but at this time there would seem to be no good reason for encumbering a double star catalogue with that kind of material. We know now that they can have no interest as double stars in the proper sense of the term. With the large telescope pairs of 5″ or 6″ distance in the lower magnitudes of the Durchmusterung can be found by the score on any

night, even when the seeing is too poor for ordinary micrometrical work; and with the 12-inch it would be easy to make a large list in a comparatively short time. I have not allowed myself to find new pairs of the kind recorded here, any faster than they could be thoroughly measured. It may be many years before some of these are re-observed, and it is desirable to have a careful set of measures at this time with which to compare future observations.

At the end of the double star observations will be found a few new nebulæ which have been incidentally found in the course of the other work.

All places, as in my previous catalogues, are for 1880.

β 1155. D.M. (3°) 4933.

R. A. $0^h\ 0^m\ 40^s$
Decl. $+\ 3°\ 47'$

1890.802	91.1	0.45	8.6 . . . 9.0	36
.824	86.7	0.46	9.0 . . . 9.5	36
.840	93.4	0.41	8.6 . . . 9.5	36
1890.82	90.4	0.44	8.7 . . . 9.3	

β 1156. D.M. (63°) 48.

R. A. $0^h\ 19^m\ 58^s$
Decl. $+\ 63°\ 46'$

1890.725	31.7	0.52	9.5 . . . 9.6	36
.747	33.9	0.57	9.0 . . . 9.1	36
.760	30.2	0.48	9.0 . . . 9.2	36
1890.74	31.9	0.52	9.2 . . . 9.3	

This pair, and the one next following, were found during an examination of the place given by D'ARREST for TYCHO BRAHE'S star. That is a little s. p. this star.

β 1157. D.M. (63°) 52.

R. A. $0^h\ 22^m\ 30^s$
Decl. $+\ 63°\ 35'$

1890.725	89.7	1.65	8.5 . . 11.5	36
.747	90.7	1.68	8.3 . . 11.5	36
.760	90.1	1.64	8.5 . . 11.0	36
1890.74	90.2	1.66	8.4 . . 11.3	

This is 8.0-m in D.M. Discovered with the 12-inch. Much easier than the preceding pair, which is in the same vicinity.

β 1158. L. 718.

R. A. $0^h\ 24^m\ 55^s$
Decl. $-\ 10°\ 45'$

B and C.

1890.898	138.6	0.20	8.8 . . . 8.8	36
.900	135.4	0.29	8.5 . . . 8.5	36
.939	140.4	0.28	8.5 . . . 8.5	36
1890.91	138.1	0.26	8.6 . . . 8.6	

A and BC (= H. 1981).

1890.898	86.6	79.22	5.5 . . .	36
.933	86.4	79.31	7.3 . . .	36
.939	86.7	79.41	7.8 . . .	36
1890.91	86.6	79.31	. . .	

The wide pair constitutes the double star, H. 1981. The R.A. in HERSCHEL is 1^m too large. He gave the angle 84°.8, and the estimated distance 60″, and the magnitudes 8 and 9. The magnitude of the companion in S.D. is 8.6. The different magnitudes given to the principal star cover a wide range: LALANDE and SCHJELLERUP, 8; GOULD, 7.5; SCHÖNFELD, 7.2; HEIS, 6.7; and my own estimate in the first observation, which made it still brighter. It is not known as a variable star, but it seems hardly possible that the magnitudes could differ so much if there is really no change in brightness. It would be well for variable star observers to give it a little attention.

The new pair is a difficult object, and likely to prove an interesting one.

β 1159. D.M. (39°) 148.

R. A. 0h 32m 28s
Decl. + 40° 1′

	°	″		
1890.681	37.2	0.25	10.0 . . 10.2	36
.687	43.4	0.29	9.3 . . 9.5	36
.689	44.6	0.16	9.8 . . 10.0	36
1890.68	41.7	0.23	9.7 . . 9.9	

This unusually minute and difficult pair is involved in the extreme preceding end of the Great Nebula in *Andromeda*. The magnitude is 8.9 in D.M. It is difficult enough to test the powers of even the 36-inch, and probably no other telescope will show it well.

β 1160. B.A.C. 230.

R. A. 0h 43m 24s
Decl. — 14° 13′

	°	″		
1890.675	114.2	1.39	6.0 . . 13.0	36
.689	112.4	1.18	5.5 . . 11.5	36
.709	112.7	1.01	6.0 . . 11.5	36
1890.69	113.1	1.19	5.8 . . 12.0	

The magnitude in GOULD is 5.9.

β 1161. L. 1766.

R. A. 0h 55m 50s
Decl. + 51° 9′

	°	″		
1890.689	324.2	0.53	6.8 . . . 7.5	36
.709	323.0	0.45	7.0 . . . 7.5	36
.725	325.5	0.45	7.0 . . . 8.0	36
1890.71	324.2	0.48	6.9 . . . 7.7	

β 1162. D.M. (35°) 215.

R. A. 1h 3m 52s
Decl. + 35° 18′

	°	″		
1890.675	142.2	0.31	8.8 . . . 9.0	36
.681	138.2	0.36	9.3 . . . 9.4	36
.689	140.5	0.36	9.5 . . . 9.7	36
1890.68	140.3	0.34	9.2 . . . 9.4	

This close pair is about 25′ n. f. *β Andromedae*.

β 1163. Ceti 199.

R. A. 1h 18m 18s
Decl. — 7° 32′

	°	″		
1890.675	195.1	0.17	6.0 . . . 6.0	36
.681	194.5	0.15	6.0 . . . 6.5	36
.689	187.2	0.24	6.0 . . . 6.0	36
1890.68	192.3	0.19	6.0 . . . 6.2	

β 1164. 95 Piscium.

R. A. 1h 21m 26s
Decl. + 4° 44′

	°	″		
1890.802	167.0	0.42	7.0 . . . 7.5	36
.824	168.7	0.39	6.5 . . . 6.8	36
.832	169.4	0.35	6.5 . . . 7.0	36
1890.82	168.4	0.39	6.7 . . . 7.0	

In the B.A.C. this is 95 *Piscium*, 7-m. The magnitude in the D.M. is 8.0, and in Boss, 7.3.

β 1165. W_2 I. 510.

R. A. 1h 24m 51s
Decl. + 40° 27′

	°	″		
1890.807	61.4	2.02	8.3 . . 12.0	12
.829	68.1	1.69	8.0 . . 12.0	12
.835	57.0	1.90	8.7 . . 12.0	12
.854	63.2	1.66	8.8 . . 12.5	12
1890.83	62.4	1.82	8.4 . . 12.1	

Found and measured with the 12-inch. It is a difficult pair with that instrument.

β 1166. L. 2980.

R. A. 1h 31m 45s
Decl. + 37° 53′

	°	″		
1890.807	346.7	2.64	8.3 . . 11.0	12
.829	343.7	2.43	8.5 . . 11.5	12
.835	347.1	2.81	8.3 . . 12.0	12
1890.82	345.8	2.63	8.4 . . 11.5	

Discovered with the 12-inch.

β 1167. W_2 I. 716.

R. A. 1h 33m 16s
Decl. + 38° 7′

	°	″		
1890.807	56.5	1.16	9.5 . . 11.0	12
.829	56.6	1.29	9.2 . . 10.5	12
.835	55.4	1.30	9.3 . . 10.5	12
1890.82	56.2	1.25	9.3 . . 10.7	

Discovered and measured with the 12-inch. The magnitude in D.M. is 8.8.

β 1168. Schj. 534.

R. A. 1h 43m 48s
Decl. — 10° 58′

	°	″		
1890.675	202.5	0.32	8.0 . . . 8.2	36
.681	204.0	0.31	8.0 . . . 8.7	36
.689	202.5	0.36	8.3 . . . 8.5	36
.785	203.2	0.30	7.5 . . . 8.0	36
1890.71	203.0	0.32	8.0 . . . 8.3	

This close pair is 1m 44s preceding, and 2′.4 south of *ζ Ceti*.

β 1169. D.M. (51°) 420.

R. A. 1h 44m 17s
Decl. + 51° 46′

	°	″		
1890.835	207.3	2.08	8.5 . . 12.0	12
.854	202.8	2.33	8.5 . . 12.5	12
.856	209.0	2.18	8.5 . . 12.5	12
1890.85	206.4	2.20	8.5 . . 12.3	

Discovered with the 12-inch.

β 1170. χ Persei.

R. A. 2h 9m 39s
Decl. + 56° 58′

B and C.

	°	″		
1890.687	311.6	0.35	11.0 . . 11.5	36
.760	313.4	0.25	12.0 . . 12.1	36
.785	314.8	0.20	11.5 . . 11.5	36
1890.74	313.3	0.27	11.5 . . 11.7	

A and BC.

	°	″		
1890.687	353.2	70.35	6.3 . .	36
.689	353.2	70.48	6.2 . . 11.0	36
.785	353.6	70.33	. .	36
1890.72	353.3	70.39	. .	

The companion to the principal star in the great cluster in *Perseus* is an exceedingly minute and close pair, and of the last degree of difficulty. I do not think another telescope can possibly show this pair. The distance in the first measure was noted as "too large." It resembles the one found in the nebula of *Andromeda*, but is very much fainter, and correspondingly more difficult.

The only other measures of this distant companion were made with the Chicago refractor:

	°	″		
1879.55	352.6	70.47	β	2 n

A still more distant companion makes S 409.

β 1171. D.M. (56°) 556.

R. A. 2h 12m 45s
Decl. + 56° 18′

	°	″		
1890.687	23.9	1.11	8.5 . . 13.5	36
.689	21.2	1.13	8.7 . . 13.5	36
.760	19.2	0.80	8.7 . . 12.5	36
1890.71	21.4	1.01	8.6 . . 13.2	

Another pair in the great *Perseus* cluster; the south star of two, about 1′ apart. The magnitude is 9.2 in D.M.

β 1172. D.M. (56°) 635.

R. A. 2h 21m 26s
Decl. + 56° 42′

	°	″		
1890.687	238.0	1.65	8.7 . . 10.0	36
.689	237.8	1.65	8.6 . . 11.5	36
.760	239.2	1.63	8.0 . . 10.5	36
1890.71	238.3	1.64	8.4 . . 10.9	

This is also in the borders of the *Perseus* cluster.

β 1173. Arietis 133.

R. A. 2h 50m 4s
Decl. + 23° 32′

A and B.

	°	″		
1890.879	326.0	0.11	7.7 . . . 7.8	36
.882	324.8	0.14	7.5 . . . 7.6	36
.893	325.5	0.13	7.8 . . . 8.0	36
1890.88	325.4	0.13	7.7 . . . 7.8	

AB and C.

1890.879	283°.7	4".54	7.5 . . 12.5	36
.882	285.1	4.64	. . 13.5	36
.893	282.0	4.72	. . 13.0	36
1890.88	283.6	4.63	. . 13.0	

A fine triple star, but the close pair is very difficult. The principal star (= L. 5468 = W_2 II. 1202) is 6.8 in the D.M.

β 1174. L. 5683.

R. A. 2h 57m 46s
Decl. — 11° 26′

1890.802	304°.9	1".25	7.8 . . 11.0	36
.832	305.7	1.16	7.5 . . 12.0	36
.840	307.1	1.24	7.7 . . 11.0	36
1890.82	305.9	1.22	7.7 . . 11.3	

Discovered with the 12-inch.

β 1175. L. 5636.

R. A. 2h 57m 47s
Decl. + 43° 14′

1890.673	282°.8	0".25	7.0 . . . 8.5	36
.675	280.0	0.22	7.0 . . . 8.5	36
.681	280.0	0.30	8.0 . . . 9.0	36
1890.68	280.9	0.26	7.3 . . . 8.7	

β 1176. 48 Cephei (H).

R. A. 3h 5m 9s
Decl. + 77° 17′

A and B.

1890.633	281°.1	1".21	. . 11.0	36
.652	274.9	1.06	. . 13.0	36
.673	276.7	1.26	. . 13.5	36
1890.65	277.6	1.18	. . 12.5	

A and C.

1890.610	228°.0	10".81	5.5 . . 13.5	36
.633	228.0	11.11	5.5 . . 13.0	36
.652	227.8	10.94	6.0 . . 13.5	36
1890.63	227.9	10.95	5.7 . . 13.3	

A fine triple, but not a very easy one. The outside companion was measured twice before the close star was detected. This is B.A.C. 979.

β 1177. Lamont 464.

R. A. 3h 12m 45s
Decl. — 1° 28′

1890.802	24°.0	0".45	9.3 . . . 9.3	36
.824	24.6	0.38	9.0 . . . 9.0	36
.832	25.4	0.32	9.0 . . . 9.0	36
1890.82	24.7	0.38	9.1 . . . 9.1	

Found during one of the many attempts to see that most singular double star, 95 *Ceti*. This new pair is 31s.7 f., and 5′ 42″ s. of that star. The magnitude in S.D. is 9.3.

β 1178. Tauri 7 = L. 6267.

R. A. 3h 17m 20s
Decl. + 4° 27′

1890.882	347°.5	0".90	6.5 . . 12.0	36
.890	346.2	1.11	6.7 . . 12.0	36
.898	349.7	0.97	6.5 . . 13.0	36
1890.89	347.8	0.99	6.6 . . 12.3	

The magnitude in the D.M. is 7.7, and in Boss, 7.3; while GOULD gives 6.6. It certainly is as bright as that now.

β 1179. 34 Persei.

R. A. 3h 20m 47s
Decl. + 49° 6′

1890.610	162°.0	0".68	6.5 . . 11.0	36
.633	161.6	0.76	6.0 . . 11.0	36
.652	164.1	0.68	5.5 . . 12.5	36
.660	166.0	0.60	5.5 . . 12.0	36
1890.64	163.4	0.68	5.9 . . 11.6	

A more difficult pair than the distance and relative magnitudes would indicate.

β 1180. L. 6417.

R. A. 3h 22m 23s
Decl. — 4° 59′

A and B.

1890.802	24°.7	0".42	8.5 . . 9.0	36
.824	24.6	0.46	8.5 . . 9.0	36
.832	25.2	0.45	8.0 . . 10.0	36
1890.82	24.8	0.44	8.3 . . 9.3	

A and C.

1890.802	117°.6	7".09	. . 12.0	36
.824	118.3	7.16	. . 11.5	36
.832	117.8	7.15	. . 11.0	36
1890.82	117.9	7.13	. . 11.5	

β 1181. L. 6685.

R. A. 3h 32m 53s
Decl. + 45° 31′

1890.652	270°.5	0".36	8.0 . . . 8.1	36
.660	266.9	0.31	8.3 . . . 8.5	36
.673	274.2	0.38	8.0 . . . 8.3	36
1890.66	270.5	0.35	8.1 . . . 8.3	

Near $O\Sigma$ 59.

β 1182. L. 6759.

R. A. 3h 35m 28s
Decl. + 48° 9′

A and B.

1890.610	260°.3	4".56	6.0 . . 13.5	36
.630	262.1	4.24	6.5 . . 14.5	36
.633	. . .	4.31	6.8 . . 14.5	36
1890.62	261.2	4.37	6.4 . . 14.2	

A and C.

1890.610	242°.9	19".56	. . 13.0	36
.630	242.4	19.20	. . 13.5	36
.633	. . .	19.04	. . 14.0	36
1890.62	242.6	19.27	. . 13.5	

The micrometer was disturbed during the evening of the last measure, and some of the position-angles were lost.

β 1183. B.A.C. 1142.

R. A. 3h 37m 35s
Decl. + 45° 18′

1890.610	139°.3	6".44	6.0 . . 14.5	36
.660	139.8	6.19	6.5 . . 14.5	36
.673	140.5	6.82	6.5 . . 15.0	36
1890.65	139.9	6.48	6.3 . . 14.7	

β 1184. D.M. (21°) 526.

R. A. 3h 41m 14s
Decl. + 22° 0′

1890.785	272°.9	0".66	8.2 . . . 8.3	36
.851	271.8	0.61	8.0 . . . 8.5	36
.867	272.0	0.59	8.0 . . . 8.2	36
1890.83	272.3	0.62	8.1 . . . 8.3	

β 1185. W_2 IV. 376.

R. A. 4h 18m 52s
Decl. + 18° 35′

1890.660	33°.6	0".15	7.6 . . . 8.5	36
.681	18.3	0.16	8.0 . . . 8.5	36
.689	25.1	0.18	8.0 . . . 8.5	36
.775	25.4	0.14	7.5 . . . 8.0	36
1890.70	25.6	0.16	7.8 . . . 8.4	

The magnitude in D.M. is 7.5.

β 1186. Tauri 248 = L. 8372.

R. A. 4h 20m 51s
Decl. + 10° 56′

1890.906	185°.0	0".63	6.8 . . 9.5	36
.911	180.4	0.61	6.7 . . 9.0	36
.939	181.0	0.53	6.8 . . 10.5	36
1890.92	182.1	0.59	6.8 . . 9.7	

In ARGELANDER and HEIS, 6.0-m, and as bright as that in most of the catalogues.

β 1187. 5 Camelopardi.

R. A. 4h 45m 14s
Decl. + 55° 4′

1890.775	245°.4	12".86	5.5 . . 12.0	36
.777	245.3	12.90	5.5 . . 13.5	36
.785	244.9	12.90	5.5 . . 13.0	36
1890.78	245.2	12.89	5.5 . . 12.8	

β 1188.

R. A. 5h 44m 33s
Decl. — 1° 28′

A and B.

1890.832	103°.0	1".01	7.8 . . 10.5	36
.840	108.4	1.29	8.0 . . 10.5	36
.851	106.7	1.38	7.8 . . 10.0	36
1890.84	106.0	1.23	7.9 . . 10.3	

A and C (= Σ 809).

1890.840	98°.5	25".38	...9.0	36
.851	98.1	25.22	...8.5	36
.862	98.4	25.37	7.8...8.5	36
1890.85	98.3	25.32	...8.7	

The new pair is the principal star of Σ 809. The STRUVE star appears to be fixed:

1831.16	101°.2	25".70	Σ	3 n
1868.56	99.6	25.25	Δ	4 n
1879.02	98.3	25.22	β	2 n

β 1189. Schj. 1985.

R. A. 5h 51m 8s
Decl. + 0° 23′

A and B.

1890.879	267°.4	0".23	8.0...9.0	36
.890	271.2	0.13	8.3...9.0	36
.939	269.8	0.23	8.0...9.2	36
1890.90	269.5	0.20	8.1...9.1	

AB and C.

1890.840	194°.5	58".02	...8.0	36
.862	194.5	58.21	8.0...8.0	36
1890.85	194.5	58.11	...8.0	

The magnitudes of A and B in the D.M. are 9.0 and 9.2. D.M. (0°) 1230, 1229.

β 1190. W_1 V. 1269.

R. A. 5h 51m 17s
Decl. + 0° 1′

A and B.

1890.840	341°.2	1".25	7.0..10.5	36
.851	339.5	1.37	7.8..11.0	36
.862	339.7	1.61	7.5..11.0	36
1890.85	340.1	1.41	7.4..10.8	

A and C.

1890.840	95°.2	6".72	..13.0	36
.851	95.2	6.62	..12.0	36
.862	96.0	6.62	..12.5	36
1890.85	95.5	6.65	..12.5	

A triple star near the last. The distant companion is noted in the Harvard zones, where it is called 17 magnitude, and distance estimated 8".

β 1191. L. 12262.

R. A. 6h 19m 9s
Decl. + 18° 50′

1890.890	163°.0	1".45	6.8..14.0	36
.939	162.3	1.42	7.0..14.5	36
.955	159.1	1.13	7.3..13.0	36
1890.93	161.5	1.33	7.0..13.8	

A difficult pair most of the time.

β 1192. ν Geminorum.

R. A. 6h 21m 50s
Decl. + 20° 17′

B and C.

1890.879	341°.0	0".14	9.0...9.2	36
.882	349.1	0.18	8.5...8.6	36
.890	348.4	0.12	8.5...8.7	36
1890.88	346.2	0.15	8.7...8.8	

A and BC (= OΣ App. 77).

1890.854	329°.3	112".48	...	36
.862	329.2	112.80	...	36
.879	329.5	112.80	...	36
1890.86	329.3	112.69	...	

This is one of the bright stars, with distant companions, given in OΣ's catalogue of wide pairs. This companion star is an exceedingly close double, and one not likely to be found with any much smaller telescope. One would expect rapid motion in such a pair. The only other measures of this from the large star are the following:

1876.02	329°.1	112".54	Δ	3 n

Evidently there has been no change. If the principal star has any proper motion it is extremely small. The large telescope shows a number of faint stars nearer than this companion. I have measured most of them. The nearest one is quite difficult to measure, but the others are easily seen.

A and a.

1890.862	359°.3	22".30	..15.0	36
.879	356.9	22.78	..15.0	36
.890	357.9	22.86	..15.0	36
1890.88	358.0	22.65	..15.0	

A and b.

1890.862	13.6	53.99	. . 13.0	36
.879	13.0	53.80	. . 14.5	36
1890.87	13.3	53.90	. . 13.8	

A and c.

1890.862	254.3	57.06	. . 12.0	36
.890	255.0	56.47	. . 13.0	36
1890.87	254.6	56.76	. . 12.5	

A and d.

1890.862	11.5	92.22	. . 12.0	36
.879	11.7	92.04	. . 14.0	36
1890.87	11.6	92.13	. . 13.0	

β 1193. 36 Geminorum.

R. A. $6^h\ 42^m\ 52^s$
Decl. $+\ 21^\circ\ 56'$

1890.879	355.8	10.62	6.0 . . 15.0	36
.890	355.2	11.05	5.0 . . 14.5	36
.939	354.1	10.76	6.0 . . 14.0	36
1890.90	355.0	10.81	5.7 . . 14.5	

A very small companion.

β 1194. 65 Geminorum.

R. A. $7^h\ 22^m\ 21^s$
Decl. $+\ 28^\circ\ 10'$

1890.879	289.1	13.89	5.0 . . 14.0	36
.882	289.7	14.06	5.5 . . 14.5	36
.890	289.8	13.77	6.0 . . 13.5	36
1890.88	289.5	13.91	5.5 . . 14.0	

A faint attendant similar to the last.

β 1195. L. 15331.

R. A. $7^h\ 45^m\ 35^s$
Decl. $-\ 9^\circ\ 6'$

1890.903	81.7	0.46	7.5 . . . 8.0	36
1891.052	80.8	0.43	7.0 . . . 7.2	36
.055	81.8	0.49	7.5 . . . 7.7	36
1891.00	81.4	0.46	7.3 . . . 7.6	

β 1196. D.M. (60°) 1127.

R. A. $8^h\ 8^m\ 55^s$
Decl. $+\ 59^\circ\ 57'$

1890.882	63.0	0.44	8.5 . . 10.5	36
1891.052	61.0	0.46	8.5 . . 10.5	36
1890.97	62.0	0.45	8.5 . . 10.5	

This is 63ˢ f. a 6.0-m star, and 40″ n. The magnitude in D.M. is 9.2.

β 1197. Lac. 5791.

R. A. $13^h\ 56^m\ 4^s$
Decl. $-\ 31^\circ\ 6'$

1890.375	176.3	0.94	6.5 . . . 7.5	36
.436	179.4	0.97	7.0 . . . 8.5	12
.438	180.9	0.66	7.0 . . . 8.2	12
1890.41	178.9	0.86	6.8 . . . 8.1	

Discovered with the 12-inch.

β 1198. τ Herculis.

R. A. $16^h\ 16^m\ 8^s$
Decl. $+\ 46^\circ\ 36'$

1890.334	145.3	6.76	4.0 . . 13.5	36
.340	145.1	6.34	4.0 . . 14.0	36
.356	144.3	6.67	. . 14.0	36
.373	146.5	6.50	. . 14.0	36
1890.35	145.3	6.57	. . 13.9	

A very minute companion. (See p. 88.)

β 1199. Messier 13.

R. A. $16^h\ 37^m$
Decl. $+\ 36^\circ\ 41'$

A and B.

1890.422	131.9	2.64	10.5 . . 11.0	36
.458	129.1	2.35	11.0 . . 11.5	36
.460	130.0	2.85	11.0 . . 11.7	36
1890.45	130.3	2.61	10.8 . . 11.4	

B and C.

1890.422	59.4	0.84	. . 12.0	36
.458	59.8	0.96	. . 12.5	36
.460	58.9	0.84	. . 14.0	36
1890.45	59.4	0.88	. . 12.8	

This is one of the principal stars, and near the central portion of the great cluster in *Hercules*. It was the only pair close enough to be called a double star, I could find on this occasion; but the conditions were not specially favorable. Of course there are many stars within, say, 2″ of each other; but in all of the bright compressed clusters which I have examined with this and other instruments, there seems to be a remarkable absence of real double stars, and this seems to be true of star clusters generally.

β 1200. L. 31421.

R. A. 17h 11m 5s
Decl. + 14° 49′

	°	″		
1890.422	13.5	1.41	8.0 . . 11.5	36
.447	12.7	1.52	7.5 . . 12.5	36
.458	10.5	1.33	8.0 . . 12.5	36
1890.44	12.6	1.42	7.8 . . 12.2	

This is the preceding of two 8-m stars, same declination, and 33s apart. Near *α Herculis*.

β 1201. O. Arg. N. 17215.

R. A. 17h 26m 40s
Decl. + 67° 52′

	°	″		
1890.463	339.0	0.43	7.0 . . . 7.0	36
.496	337.1	0.39	8.0 . . . 8.2	36
.499	338.4	0.48	8.3 . . . 8.3	36
1890.49	338.2	0.43	7.8 . . . 7.8	

β 1202. D.M. (3°) 3564.

R. A. 17h 55m 33s
Decl. + 3° 33′

A and B.

	°	″		
1890.463	351.6	0.75	8.0 . . 9.0	36
.479	353.5	0.83	8.5 . . 10.0	36
.496	354.1	0.65	8.0 . . 9.0	36
1890.48	353.1	0.74	8.2 . . 9.3	

C and D.

	°	″		
1890.463	92.2	3.85	8.7 . . 11.5	36
.479	93.2	3.99	10.0 . . 11.0	36
.496	94.3	3.89	9.5 . . 11.5	36
1890.48	93.2	3.91	9.4 . . 11.3	

AB and C.

	°	′		
1890.463	28.2	104.00	. . .	36
.473	28.4	104.02	. . .	12
.476	28.3	103.73	. . .	36
.479	28.1	103.72	. . .	36
1890.47	28.2	103.87	. . .	

AB and E.

	°	″		
1890.473	138.4	90.18	9.0 . . . 8.8	12
.476	138.4	90.44	8.5 . . . 8.4	36
.479	138.6	90.34	8.5 . . . 8.4	36
1890.47	138.5	90.32	8.7 . . . 8.5	

A and C are, respectively, LAMONT 2849 and 2852, but the declination of the latter should be 1′ more. The magnitudes of these stars in D.M. are the same, 8.2.

β 1203. Serpentis 191.

R. A. 18h 19m 56s
Decl. + 0° 44′

	°	″		
1890.652	67.4	0.30	7.0 . . . 7.3	36
.675	66.9	0.31	8.0 . . . 8.2	36
.689	69.1	0.29	7.5 . . . 7.7	36
1890.67	67.8	0.30	7.5 . . . 7.7	

A very close and nearly equal pair. This is L. 34015. (See p. 102.)

β 1204. Aquilae 56.

R. A. 19h 6m 1s
Decl. + 2° 25′

A and B.

	°	′		
1890.556	3.6	0.51	7.0 . . . 8.0	36
.564	4.6	0.44	8.0 . . . 8.5	36
.573	3.3	0.38	8.0 . . . 9.0	36
1890.56	3.8	0.44	7.7 . . . 8.5	

A and C.

	°	′		
1890.553	195.0	12.42	. . 14.0	36
.556	195.6	12.92	. . 14.0	36
.573	194.9	13.11	. . 14.0	36
.610	194.5	13.10	. . 14.0	36
1890.57	195.0	12.89	. . 14.0	

A and D.

1890.556	159°.9	20″.80	. . 14.5	36
.610	160.2	21.54	. . 14.5	36
.675	159.6	21.35	. . 15.5	36
1890.61	159.9	21.23	. . 14.8	

A and E.

1890.556	316°.9	26″.38	. . 14.5	36
.594	318.0	26.23	. . 14.0	36
1890.57	317.4	26.30	. . 14.2	

A and F.

1890.553	292°.8	27″.89	. . 14.0	36
.556	292.4	27.72	. . 14.0	36
.594	292.3	27.69	. . 14.0	36
1890.57	292.5	27.77	. . 14.0	

A and G (= Σ 2476).

1890.553	214°.0	31″.32	7.5 . . 10.5	36
.556	213.6	31.41	6.8 . . 10.0	36
1890.55	213.8	31.36	7.1 . . 10.2	

Not only is the principal star of Σ 2476 a close double, but there are at least four other stars nearer than the Σ companion. One of these, D, is extremely difficult to measure. There does not seem to be any change in the distant star:

1830.61	214°.7	31″.41	Σ

β 1205. L. 38649.

R. A. 20h 5m 46s
Decl. — 8° 27′

1890.644	51°.5	0″.51	8.0 . . . 9.5	12
.647	49.1	0.57	8.3 . . . 9.5	12
.649	49.3	0.60	8.0 . . . 9.2	36
1890.65	50.0	0.56	8.1 . . . 9.4	

Discovered with the 12-inch. In the S.D. this star is 7.0 magnitude.

β 1206. L. 39115.

R. A. 20h 14m 36s
Decl. + 36° 23′

1890.518	2°.8	1″.77	8.0 . . 10.5	36
.523	1.6	2.12	8.0 . . 11.0	12
.534	4.6	1.80	7.5 . . 11.0	36
1890.52	3.0	1.90	7.8 . . 10.8	

β 1207. L. 39198.

R. A. 20h 16m 25s
Decl. + 43° 28′

1890.573	217°.7	5″.74	7.5 . . 13.0	36
.575	217.1	5.79	8.0 . . 13.5	36
.592	218.7	5.75	7.5 . . 14.0	36
1890.58	217.8	5.76	7.7 . . 13.5	

One of the WOLF-RAYET stars in *Cygnus;* perfectly round and sharp, with the highest powers.

β 1208. L. 39656.

R. A. 20h 28m 38s
Decl. + 6° 28′

1890.537	335°.4	2″.77	7.3 . . 12.0	36
.556	336.3	3.00	7.5 . . 12.0	36
.564	334.8	3.04	7.5 . . 12.5	36
1890.55	335.5	2.94	7.4 . . 12.2	

β 1209. S.D. (17°) 6025.

R. A. 20h 34m 9s
Decl. — 17° 48′

1890.649	293°.8	0″.51	9.0 . . 10.5	36
.652	291.4	0.43	9.0 . . 10.0	36
.673	297.7	0.42	9.0 . . 9.3	36
1890.66	294.3	0.45	9.0 . . 9.9	

Discovered with the 12-inch. It is 22s.4 preceding, and 0′.4 south of the 7.0-m star, B.A.C. 7151.

β 1210. P. XX. 440.

R. A. 20h 56m 6s
Decl. + 48° 13′

A and B.

1890.613	120°.5	2″.16	7.5 . . 13.0	36
.630	118.4	2.35	7.6 . . 12.0	36
.633	120.8	2.38	7.7 . . 12.0	36
1890.63	119.9	2.30	7.6 . . 12.3	

C and D (= 0Σ 425).

1890.613	133°.8	4″.17	11.0 . . 11.5	36
.630	134.1	4.17	10.5 . . 11.0	36
.633	134.7	4.49	10.8 . . 11.1	36
1890.63	134.2	4.28	10.8 . . 11.2	

A and C (= $O\Sigma$ 425).

1890.613	28.°6	13.″89	..	36
.630	28.8	13.80	..	36
.633	28.4	13.70	..	36
1890.63	28.6	13.80	..	

The new star, B, is much nearer the principal star than those which constitute $O\Sigma$ 425. The distance of D has never been measured directly before. $O\Sigma$ gives the distance of CD, derived from the angles, in connection with the measures of AC, as 4″.11 (1851.7). There has probably been no change in these stars, unless the distance of C has increased. The following are all the measures:

1847.49	27.°6	12.″33	$O\Sigma$	3 n
1867.00	29.9	12.72	Δ	3 n

β 1211. L. 40744.

R. A. 20h 57m 15s
Decl. — 18° 35′

1890.644	343.°8	0.″65	8.0 . . . 8.3	36
.649	345.6	0.58	7.5 . . . 8.0	36
.652	344.6	0.50	7.0 . . . 8.0	36
1890.65	344.7	0.58	7.5 . . . 8.1	

The following star of a small triangle; discovered with the 12-inch.

β 1212. 24 Aquarii.

R. A. 21h 33m 20s
Decl. — 0° 36′

1890.725	256.°5	0.″44	6.8 . . . 7.5	36
.760	254.9	0.45	6.5 . . . 6.7	36
.777	252.0	0.45	6.2 . . . 6.5	36
1890.75	254.5	0.45	6.5 . . . 6.9	

A fine moderately close pair, and it is safe to say at the outset that it will prove to be a binary. The proper motion of this star is 0″.215 in the direction of 81°.5, and it is evident that it is common to both stars. (See p. 126.)

β 1213. D.M. (12°) 4710.

R. A. 21h 48m 26s
Decl. + 13° 0′

A and B.

1890.675	258.°7	62.″21	8.0 . . .	36
.678	258.9	62.40	8.0 . . .	36
.709	258.8	62.25	8.0 . . .	36
1890.69	258.8	62.29	8.0 . . .	

B and C.

1890.675	312.°7	0.″91	9.3 . . . 9.6	36
.678	311.5	0.75	9.0 . . . 9.5	36
.709	311.5	0.78	9.0 . . . 9.5	36
1890.69	311.9	0.81	9.1 . . . 9.5	

I found this triple with the Chicago refractor in 1884, but it has not been given in any of my previous lists of new pairs.

β 1214. D.M. (33°) 4387.

R. A. 21h 51m 23s
Decl. + 33° 45′

A and B.

1890.633	205.°8	1.″44	9.0 . . 10.3	36
.652	204.3	1.33	9.0 . . 10.5	36
.673	204.8	1.40	9.0 . . 10.0	36
1890.65	205.0	1.39	9.0 . . 10.3	

C and D.

1890.633	246.°3	5.″07	10.5 . . 11.0	36
.652	245.6	4.98	9.5 . . 10.8	36
.673	245.6	5.12	9.3 . . 10.5	36
1890.65	245.8	5.06	9.8 . . 10.8	

A and C.

1890.633	18.°4	112.″16	. . .	36
.652	18.1	112.55	. . .	36
.673	18.5	112.58	. . .	36
1890.65	18.3	112.43	. . .	

This quadruple star was noted by me in 1884, but is not included in any of my previous catalogues. There is a faint star about 20″ from C, in the direction of 285°; and a 5″ pair of faint stars between AB and CD. A good many smaller stars in the field. C is No. 4388 of the D.M.; magnitude, 9.3.

β 1215. S.D. (11°) 5781.

R. A. 22h 6m 46s
Decl. — 11° 46′

1890.802	89°.7	1″.58	9.0 . . . 9.0	36
.824	90.0	1.53	9.0 . . . 9.1	36
.840	90.9	1.49	9.0 . . . 9.0	36
1890.82	90.2	1.53	9.0 . . . 9.0	

Near the last pair; discovered with the 12-inch.

β 1216. L. 43605.

R. A. 22h 14m 41s
Decl. + 28° 55′

1890.496	318°.6	0″.65	8.3 . . . 8.5	36
.518	316.1	0.68	8.5 . . . 9.0	36
.526	318.5	0.60	8.5 . . . 8.5	36
1890.51	317.7	0.64	8.4 . . . 8.7	

I found this pair September 3, 1885, with the 16-inch refractor of the WARNER Observatory, during an evening spent with Dr. SWIFT at that place. Recently the slip of paper containing a memorandum of the place of the star was found, and it is now measured for the first time.

β 1217. L. 43635.

R. A. 22h 15m 33s
Decl. + 30° 42′

1890.499	216°.8	0″.68	7.3 . . 9.5	36
.518	221.6	0.65	7.5 . . 10.0	36
.564	218.3	0.50	7.5 . . 11.5	36
1890.53	218.9	0.61	7.4 . . 10.3	

This pair has proved exceedingly troublesome to measure. On several occasions, when the seeing appeared to be excellent, there was not the least trace of the companion. The magnitude in D.M. is 7.0.

β 1218. W_2 XXII. 476.

R. A. 22h 22m 32s
Decl. + 29° 5′

1890.523	51°.7	1″.48	8.7 . . . 8.9	12
.526	54.0	1.44	8.6 . . . 8.8	36
.534	54.8	1.40	8.5 . . . 8.8	36
1890.52	53.5	1.44	8.6 . . . 8.8	

Discovered with the 12-inch.

β 1219. S.D. (11°) 5931.

R. A. 22h 42m 27s
Decl. — 11° 42′

1890.802	310°.0	0″.56	8.7 . . . 9.2	36
.824	309.3	0.55	8.8 . . . 9.5	36
.840	304.3	0.52	8.7 . . . 9.5	36
1890.82	307.9	0.54	8.7 . . . 9.4	

This is a difficult pair, although it was discovered with the 12-inch. About 5′ n. p. there is a 6″ pair.

β 1220. ψ¹ Aquarii.

R. A. 23h 9m 35s
Decl. — 9° 44′

B and C.

1889.689	267°.1	0″.14	. . .	36
1890.610	96.2	0.20	9.5 . . . 9.6	36
.630	109.2	0.25	9.0 . . . 9.1	36
.633	. . .	0.22	9.0 . . . 9.1	36
.660	97.7	0.23	9.0 . . . 9.0	36
1890.63	101.1	0.22	9.1 . . . 9.2	

A and BC (Σ 12, App. II).

1889.673	311°.8	49″.27	. . .	36
.687	311.8	49.25	. . .	36
.689	311.8	49.48	. . .	36
1889.68	311.8	49.33	. . .	

I found, in 1889, that the HERSCHEL-STRUVE companion was a close double star, but was able to get but a single measure that year. It seemed to be much easier the following year, and the difference of the components in magnitude was obvious. The late measures indicate a considerable increase in the angle, as well as in the distance. The mean result given above includes only the measures of 1890. The micrometer was disturbed during the night on which the last measure but one was made, and the position-angle was therefore lost.

This star has remained absolutely fixed, with reference to ψ¹, since the measures by STRUVE. The large star has a considerable proper motion, given as 0″.350, annually, in the direction of 89°.8, and this is evidently common to both stars. It is not unlikely that this will prove to be a triple system of the class of which *μ Herculis* and *μ Bootis* are familiar examples, with the close pair in rapid orbital motion. It is prob-

ably a difficult object at all times, or it would have been detected by some of the many observers who have measured the wide pair. In 1880 I made a set of measures with the Chicago 18½-inch, but saw nothing of the close pair. (See p. 136.)

β 1221. D.M. (41°) 4788.

R. A. $23^h\ 22^m\ 12^s$
Decl. $+\ 41°\ 46'$

	°	″		
1890.496	145.7	1.93	9.5 . . 10.5	36
.499	144.7	1.91	9.5 . . 10.5	36
.518	145.2	1.89	9.0 . . 10.5	36
1890.50	145.2	1.91	9.3 . . 10.5	

Discovered by me at the WARNER Observatory, in 1885, on the occasion referred to in the note to No. 1216 of this list.

β 1222. D.M. (2°) 4669.

R. A. $23^h\ 22^m\ 23^s$
Decl. $+\ 2°\ 54'$

	°	″		
1890.802	37.3	1.23	9.2 . . . 9.3	36
.824	37.4	1.07	8.6 . . . 8.7	36
.840	37.5	1.13	9.0 . . . 9.0	36
1890.82	37.4	1.14	8.9 . . . 9.0	

Discovered with the 12-inch.

β 1223. D.M. (4°) 5046.

R. A. $23^h\ 39^m\ 10^s$
Decl. $+\ 4°\ 27'$

	°	′		
1890.802	297.0	1.35	8.0 . . 11.0	36
.824	298.9	1.34	8.5 . . 11.0	36
.840	299.9	1.30	7.7 . . 10.5	36
1890.82	298.6	1.33	8.1 . . 10.8	

Discovered with the 12-inch.

β 1224. L. 46942.

R. A. $23^h\ 50^m\ 52^s$
Decl. $+\ 55°\ 10'$

	°	′		
1890.725	200.9	3.98	6.7 . . 13.0	36
.747	204.8	3.94	6.7 . . 13.5	36
.760	204.2	3.90	6.5 . . 13.5	36
1890.74	203.3	3.94	6.6 . . 13.3	

The magnitude of this star in the D.M. is 7.5.

EIGHTEENTH CATALOGUE OF NEW DOUBLE STARS DISCOVERED AT THE LICK OBSERVATORY.

By S. W. Burnham.

The following observations of double stars comprise my work in this department during 1891. The miscellaneous observations of nebulæ, etc., have been published elsewhere. These measures have been made almost entirely with the large refractor. The class of stars measured has been of a character, with respect to the difficulty of the objects, to make it desirable to use as far as possible the most powerful telescope in order to secure the best results. Many of these stars are too close for any smaller aperture, and nearly all of them more or less unequal and difficult.

The past year has been perhaps less favorable than usual, taking it altogether, and particularly in the first and last months. Two evenings each week have been given as heretofore to this work, and of course the number of observations is proportional to the time. With a smaller instrument, and one therefore more quickly set, and changed from one object to another, a much larger number of measures could be made in the same time, but a different class of objects would have to be selected for observation. The large telescope can probably be handled as easily and rapidly as any instrument could be of its size and power; but at the same time there is necessarily a good deal of time consumed in shifting the telescope dome and floor when changing from one part of the sky to another. Most of the time I have been assisted by my son, A. J. Burnham, the Secretary of the Observatory, and by his aid the loss of time in handling the telescope has been reduced to the smallest possible quantity. I have occasionally made upwards of seventy measures on a single night, but forty or fifty is a good night's work, and the average is still lower. Of course this means continuous observing, without interruption, for eight or ten hours.

During this work, I have given special attention to stars from my own catalogues. This has been done partly because it is more important to measure these stars at this time than any others, since many of them are in rapid motion, and too difficult to be observed elsewhere; and partly because it was very desirable to give in the General Catalogue of all my discoveries which I have been preparing for the press, all the data possible concerning the history and motion of each pair.

Many of these stars have not been observed since the first sets of measures made about the time of discovery, principally by Baron DEMBOWSKI and myself, and it is desirable to know whether or not there has been any sensible change. A few of them have never been measured at all. These observations have shown some very remarkable changes, and have shown the existence of some of the most remarkable binary systems known. I have measured also some of the closest and most difficult binaries from the discoveries of CLARK, STRUVE, and others. It has been the intention to select only those pairs which are now too difficult to be seen, or properly measured with other telescopes used in this work. Most of these, and corresponding pairs from my own catalogues, require measuring annually. In this way, their periods will soon be determined with great accuracy. By making careful measures each year for the next ten years, we shall have a very fair knowledge of more rapid binary systems than are now known.

No effort has been made to find new pairs. Those comprised in the catalogue given herewith have been picked up almost unavoidably. Nearly the whole available time has been devoted to work on the lists of stars already referred to, and the number of pairs was so large that it was impossible even then to get them all. My observations are all made with the telescope on the west side of the pier. This is because the instrument is much more easily handled with the object east of the meridian, where in following a star before clamping in the clock, the eye-end of the telescope is pulled down instead of lifted up; and because of the more convenient position of the finder. The general methods of observing have been referred to in my previous catalogues. For the sake of brevity, I have omitted as far as possible all notes to these pairs relating to motion, previous measures, etc. All the star places are for 1880, as heretofore.

β 1225. W_2 O. 496.

R. A. $0^h\ 20^m\ 55^s$
Decl. $+\ 20^\circ\ 26'$

	°	″		
1891.845	189.3	1.20	8.0 . . 12.0	36
.854	188.9	1.15	8.3 . . 11.0	36
.859	189.8	1.10	8.0 . . 12.5	36
1891.85	189.3	1.15	8.1 . . 11.8	

The magnitude in D.M. is 7.3.

β 1226. D.M. (57°) 97.

R. A. $0^h\ 24^m\ 58^s$
Decl. $+\ 57^\circ\ 29'$

	°	″		
1891.575	187.2	0.37	8.5 . . 10.5	36
.581	190.8	0.39	8.5 . . 10.5	36
.594	194.4	0.45	8.5 . . 10.5	36
1891.58	190.8	0.40	8.5 . . 10.5	

β 1227. D.M. (57°) 98.

R. A. $0^h\ 25^m\ 41^s$
Decl. $+\ 57^\circ\ 41'$

	°	″		
1891.581	205.8	2.89	7.2 . . 11.7	36
.594	204.9	2.70	7.3 . . 11.5	36
.597	207.5	2.87	7.3 . . 11.5	36
1891.59	206.1	2.82	7.3 . . 11.6	

β 1228. D.M. (12°) 133.

R. A. $0^h\ 59^m\ 30^s$
Decl. $+\ 12^\circ\ 41'$

	°	″		
1891.578	267.2	0.81	8.3 . . . 9.0	36
.594	267.7	0.85	8.3 . . . 8.6	36
.597	268.1	0.80	8.4 . . . 9.0	36
1891.59	268.0	0.82	8.3 . . . 8.9	

This pair was discovered with the 18½-inch, at Chicago, in November, 1884. This was after the publication of my last Chicago catalogue. There are no other measures.

β 1229. Gould 1244.

R. A. 1h 13m 46s
Decl. — 35° 7′

1891.838	290°.1	1″.00	8.0 . . . 8.4	12
.840	289.9	1.13	8.0 . . . 8.5	12
.856	297.1	0.98	8.2 . . . 8.2	12
1891.84	292.4	1.04	8.1 . . . 8.4	

Discovered with the 12-inch.

β 1230. Lacaille 427.

R. A. 1h 24m 43s
Decl. — 26° 50′

1891.838	224°.5	2″.44	7.8 . . 13.0	12
.840	229.7	2.82	6.7 . . 13.0	12
.845	221.9	2.83	6.7 . . 12.0	36
.854	222.1	2.38	6.7 . . 12.0	36
1891.84	224.5	2.62	7.0 . . 12.5	

Discovered with the 12-inch. In GOULD, 6.2-m.

β 1231. D.M. (65°) 359.

R. A. 3h 32m 45s
Decl. + 65° 36′

A and B.

1891.838	14°.9	2″.36	8.0 . . 13.0	12
.840	15.0	2.84	8.2 . . 12.5	12
.843	15.4	2.80	8.3 . . 13.0	36
.845	16.1	2.44	8.2 . . 12.0	36
.854	14.2	2.78	8.2 . . 12.0	36
1891.84	15.1	2.64	8.2 . . 12.5	

A and C.

1891.838	252°.4	84″.04	. . . 8.2	12
.840	252.3	83.99	. . . 8.3	12
.843	252.5	83.46	. . . 8.3	36
.854	252.5	83.51	. . . 8.3	36
1891.84	252.4	83.75	. . . 8.3	

Discovered with the 12-inch in looking up one of the stars noted as double in the Christiania Catalogue. A and C are, respectively, Nos. 621 and 620 of that catalogue.

β 1232. W_2 III. 1286.

R. A. 4h 1m 26s
Decl. + 28° 52′

1891.903	349°.7	0″.35	8.3 . . . 9.5	36
1892.017	349.3	0.23	8.5 . . . 9.0	36
.036	352.1	0.33	8.5 . . . 9.5	36
1891.98	350.4	0.30	8.4 . . . 9.3	

HOUGH has a pair, 30′ south, which is similar to this in angle and distance, but it is easier because the components are sensibly equal. Measures of this will be found in the miscellaneous observations.

β 1233. D.M. (66°) 316.

R. A. 4h 6m 6s
Decl. + 66° 47′

1891.840	37°.3	5″.31	8.0 . . 13.5	12
.854	37.7	5.00	8.0 . . 13.0	36
.856	36.1	5.43	8.0 . . 13.5	12
.859	37.1	4.96	8.0 . . 13.0	36
1891.85	37.1	5.17	8.0 . . 13.2	

Discovered with the 12-inch. The principal star was suspected to be a close pair, but this was not verified with the large instrument. The magnitude in the Christiania Catalogue is 6.8, and in D.M., 7.4.

β 1234. W_2 IV. 205.

R. A. 4h 11m 56s
Decl. + 21° 1′

1891.804	205°.5	1″.80	8.3 . . 13.0	36
.826	205.6	1.70	8.2 . . 11.8	36
.845	205.3	1.82	8.3 . . 13.0	36
1891.82	205.5	1.77	8.3 . . 12.6	

The magnitude in D.M. is 8.8, and in WEISSE, 8.0.

β 1235. L. 8235.

R. A. 4h 17m 18s
Decl. + 22° 28′

1891.810	57°.4	0″.35	8.3 . . . 8.4	36
.854	63.7	0.33	8.5 . . . 8.6	36
.859	61.3	0.38	8.5 . . . 8.5	36
1891.84	60.8	0.35	8.4 . . . 8.5	

This close pair is near κ *Tauri*.

β 1236. L. 8833.

R. A. $4^h\ 34^m\ 26^s$
Decl. $-\ 21^\circ\ 29'$

A and B.

1891.810	116.7	1.28	7.5 . . 10.5	36
.854	121.1	1.58	8.0 . . 11.0	36
.859	117.0	1.41	8.0 . . 11.0	36
1891.84	118.3	1.42	7.8 . . 10.8	

A and C.

1891.810	313.8	40.30	. . . 8.5	36
.854	314.7	40.25	. . . 8.5	36
.859	313.7	40.17	. . . 8.5	36
1891.84	314.1	40.24	. . . 8.5	

A and C are, respectively, O. Arg. S. 3268 and 3266.

β 1237. L. 9145.

R. A. $4^h\ 46^m\ 28^s$
Decl. $+\ 23^\circ\ 21'$

1891.804	58.2	4.21	8.0 . . 10.0	36
.810	58.1	4.41	8.0 . . 11.0	36
.826	59.4	4.35	8.0 . . 10.7	36
1891.81	58.6	4.32	8.0 . . 10.6	

β 1238. L. 9373.

R. A. $4^h\ 53^m\ 53^s$
Decl. $+\ 26^\circ\ 21'$

1891.804	12.7	1.50	8.2 . . 11.5	36
.810	12.0	1.37	8.0 . . 10.3	36
.845	13.0	1.38	8.2 . . 12.0	36
1891.82	12.6	1.42	8.1 . . 11.3	

This is 19ˢ preceding, and 9′ south of the wide pair, S. 461.

β 1239.

R. A. $5^h\ 23^m\ 28^s$
Decl. $+\ 34^\circ\ 9'$

B and D.

1891.766	327.9	2.40	. . 15.0	36
.785	321.4	2.22	. . 15.5	36
1891.77	324.6	2.31	. . 15.2	

A and B (= H. 367).

1891.753	234.3	7.88	9.5 . . 10.0	36
.766	233.0	8.16	9.5 . . 10.0	36
.785	234.1	7.97	9.5 . . 9.7	36
1891.77	233.8	8.00	9.5 . . 9.9	

A and C (= H. 367).

1891.753	309.9	10.33	. . 11.5	36
.766	311.4	10.62	. . 10.5	36
.785	309.0	10.65	. . 11.5	36
1891.77	310.1	10.53	. . 11.2	

HERSCHEL's description of the wide triple is: "One of the most curious objects in the heavens. It is a triple star, forming an equilateral triangle, and placed exactly in the center of a small circular nebula, which extends a little beyond the stars on all sides, surrounding them like an atmosphere." The 36-inch shows that one of these stars is double. The only other measures of the three principal stars were made with one of the reflectors at Lord ROSSE's Observatory:

1873.77	239.2	7.1	AB
1873.77	310.5	9.7	AC

β 1240. 26 Aurigae.

R. A. $5^h\ 30^m\ 56^s$
Decl. $+\ 30^\circ\ 25'$

A and B.

1891.906	346.6	0.15	6.0 . . . 6.3	36
1892.017	343.9	0.14	5.5 . . . 5.7	36
.022	344.7	0.14	6.0 . . . 6.3	36
.057	342.3	0.18	5.0 . . . 5.5	36
1892.00	344.4	0.15	5.6 . . . 6.0	

AB and C (= Σ 753).

1891.906	268.7	12.07	. . . 8.5	36
.909	267.8	12.27	. . . 8.5	36
.969	267.6	12.39	. . . 8.7	36
1892.017	269.2	12.27	. . . 9.0	36
1891.95	268.3	12.25	. . . 8.7	

AB and D (= β 90).

1891.909	112.6	32.14	. . 10.7	36
.969	112.8	32.35	. . 10.8	36
1892.022	112.6	32.51	. . 11.5	36
1891.97	112.7	32.33	. . 11.0	

The close pair was discovered with the 36-inch. The Σ companion has remained absolutely fixed with reference to the large star, and of course the more distant star is only an optical companion. My distance of this star is erroneously printed 25″.86 in my measures of 1877. It should have been 31″.47. There is hardly a doubt that the close pair will prove to be a binary, and perhaps in rapid motion.

β 1241. 3 Geminorum.

R. A. $6^h\ 2^m\ 27^s$
Decl. $+\ 23^\circ\ 8'$

A and B.

1891.810	344°.8	0″.50	5.7 . . 10.5	36
.854	343.6	0.58	6.0 . . 9.0	36
.859	345.8	0.50	6.0 . . 10.5	36
1891.84	344.7	0.53	5.9 . . 10.0	

A and C.

1891.854	63°.3	18″.36	. . 14.5	36

Found in measuring 4 *Geminorum* (β 1058), which is 46ˢ following, and 7′ south. The latter is closer than this pair, but easier, as the components are nearly equal.

β 1242. Schj. 2066.

R. A. $6^h\ 3^m\ 42^s$
Decl. $-\ 6^\circ\ 18'$

A and B.

1891.854	122°.5	0″.52	8.7 . . . 9.0	36
.859	126.2	0.48	8.5 . . . 8.7	36
.903	124.7	0.45	8.5 . . . 8.6	36
1891.87	124.5	0.48	8.6 . . . 8.8	

AB and C (= H. 2298).

1891.854	92°.6	43″.87	. . 10.5	36
.959	92.8	44.00	. . 11.0	36
.903	93.4	43.74	. . 10.5	36
1891.87	92.9	43.87	. . 10.7	

The wide pair, H. 2298, is in the nebula IV. 38 (= h. 381). The principal star, which is now found to be a close pair, occupies the center of a faint, diffused nebula. (See p. 178.) There are no other measures of the distant star. HERSCHEL estimated it: 90°: 35″: 8 . . . 10.

β 1243. B.A.C. 2759.

R. A. $8^h\ 7^m\ 19^s$
Decl. $+\ 18^\circ\ 2'$

1891.227	343°.6	1″.44	7.0 . . 13.0	36
.246	345.9	1.37	7.2 . . 13.0	36
1892.057	343.7	1.27	7.5 . . 13.5	36
1891.51	344.4	1.36	7.2 . . 13.2	

This star is 2^m following ζ *Cancri*, and 104″ north. It is the star to which I called attention (*Monthly Notices*, April, 1891) as being a suitable comparison star for C of ζ *Cancri*, for the purpose of determining whether or not the latter has any variable motion, produced by an invisible disturbing body. For measures of the difference in declination of this star and ζ *Cancri*, see *Monthly Notices* for November, 1892.

β 1244. D.M. (2°) 1904.

R. A. $8^h\ 7^m\ 31^s$
Decl. $+\ 2^\circ\ 21'$

1891.225	50°.0	0″.78	7.7 . . . 8.0	36
.227	49.9	0.80	8.0 . . . 8.2	36
.244	50.9	0.63	8.0 . . . 8.2	36
1891.23	50.3	0.74	7.9 . . . 8.1	

β 1245. ζ Corvi.

R. A. $12^h\ 14^m\ 21^s$
Decl. $-\ 21^\circ\ 33'$

1891.285	42°.8	4″.85	6.0 . . 13.5	36
.326	41.4	4.86	5.0 . . 14.0	36
.331	42.6	4.73	5.5 . . 14.0	36
1891.31	42.3	4.81	5.5 . . 13.8	

A very faint companion, and rather difficult in this latitude.

β 1246. B.A.C. 4740.

R. A. $14^h\ 12^m\ 12^s$
Decl. $-\ 25^\circ\ 16'$

A and B.

1891.392	184°.6	3″.23	6.0 . . 13.5	36
.419	187.7	2.98	5.5 . . 13.0	36
.473	189.0	2.77	5.0 . . 13.5	36
1891.43	187.1	2.99	5.5 . . 13.3	

A and C.

1891.419	88.°8	36.″25	. . 11.0	36

This is a naked-eye star, in *Hydra*. HEIS, 6.5-m; GOULD, 6.3.

β 1247. L. 31296.

R. A. 17h 7m 2s
Decl. — 9° 9′

1891.452	343.°1	1.″40	8.3 . . 9.5	36
.487	349.1	2.02	8.0 . . 10.7	12
.490	344.0	1.52	8.0 . . 11.0	12
.502	345.8	1.56	7.8 . . 10.0	36
1891.48	345.5	1.62	8.0 . . 10.3	

β 1248. D.M. (4°) 3406.

R. A. 17h 16m 31s
Decl. + 4° 29′

1891.452	164.°3	8.″52	8.0 . . . 9.0	36
.455	164.7	8.31	8.0 . . . 9.5	36
.482	167.1	8.64	8.0 . . . 9.5	12
1891.46	165.4	8.49	8.0 . . . 9.3	

β 1249. D.M. (53°) 1938.

R. A. 17h 19m 30s
Decl. + 53° 58′

A and B.

1891.416	79.°7	0.″44	8.8 . . . 9.0	36
.419	79.9	0.41	9.0 . . . 9.0	36
.455	80.8	0.48	8.7 . . . 8.9	36
1891.43	80.1	0.44	8.8 . . . 9.0	

AB and C.

1891.395	74.°2	62.″41	. . . 9.0	36
.416	74.2	62.63	. . . 9.0	36
.419	74.4	62.33	. . . 9.0	36
1891.41	74.3	62.46	. . . 9.0	

Close pair discovered with the 12-inch. It is very difficult with that aperture. C is D.M. (54°) 1875. A is RÜMKER 5837.

β 1250.

R. A. 17h 20m 16s
Decl. + 30° 52′

1891.709	63.°7	2.″00	9.3 . . . 9.4	36
.728	63.8	2.05	9.5 . . . 9.6	36
1891.72	63.7	2.02	9.4 . . . 9.5	

This was discovered with the 6-inch in May, 1876, but inadvertently omitted from the catalogues of that time. It has been previously measured as follows:

1877.26	57.°6	1.″93	Δ	3 n
1884.65	60.2	1.41	Ho	2 n

The measures appear to indicate some change in the angle. It is the south star of a small equilateral triangle of stars, all in the same field.

β 1251. B.A.C. 5991.

R. A. 17h 36m 55s
Decl. + 16° 2′

1891.537	80.°8	1.″40	6.0 . . 11.5	36
.540	78.5	1.42	6.0 . . 11.5	36
.597	77.7	1.30	6.0 . . 11.5	36
1891.56	79.0	1.37	6.0 . . 11.5	

This pair was discovered with the 18½-inch, at Chicago, but not included in the catalogues of new pairs issued at that time It is a naked-eye star, in *Ophiuchus*. In D.M., 5-m; HEIS, 6; Harvard, 5.7.

β 1252. L. 33818.

R. A. 18h 15m 55s
Decl. — 11° 55′

1891.419	182.°9	1.″32	8.7 . . . 9.0	36
.845	182.8	1.08	8.3 . . . 8.8	36
.487	182.5	1.28	8.2 . . . 8.6	12
1891.46	182.7	1.23	8.4 . . . 9.1	

This was discovered with the 18½-inch, at Chicago, in June, 1875, but inadvertently omitted from my published catalogues. The only other measures are:

1876.70	182.°4	1.″21	Δ	3 n

β 1253. Lyrae 28.

R. A. 18h 28m 24s
Decl. + 30° 28′

1891.326	157°.0	7″.68	6.0 . . 13.5	36
.392	155.9	7.42	6.0 . . 13.5	36
.416	155.9	7.21	6.5 . . 13.5	36
1891.38	156.3	7.44	6.2 . . 13.5	

This is a naked-eye star, in *Lyra*. HEIS, 6.5-m. LALANDE 34418.

β 1254. W1 XVIII. 935.

R. A. 18h 38m 52s
Decl. — 13° 48′

1891.419	77°.0	2″.96	8.0 . . 10.0	36
.485	76.9	2.95	8.0 . . 9.5	36
.487	76.3	2.48	8.2 . . 12.0	36
.531	81.3	2.13	8.5 . . 11.8	12
.534	82.5	2.75	8.2 . . 11.5	12
.537	75.2	2.77	8.2 . . 11.0	12
1891.50	78.2	2.67	8.2 . . 11.0	

This pair was discovered with the 18½-inch, at Chicago, in 1875, but not inserted in the catalogues of that time. It has not been measured before.

β 1255. B.A.C. 6476.

R. A. 18h 51m 37s
Decl. + 48° 43′

1891.559	85°.1	1″.55	6.0 . . 13.0	36
.575	89.0	1.54	5.5 . . 13.0	36
.610	90.0	1.60	6.0 . . 11.5	36
1891.58	88.0	1.56	5.8 . . 12.5	

β 1256. W1 XIX. 265.

R. A. 19h 12m 36s
Decl. + 6° 7′

1891.559	39°.8	0″.68	8.2 . . . 8.2	36
.562	34.7	0.66	8.5 . . . 8.5	36
.575	36.9	0.58	8.3 . . . 8.3	36
1891.56	37.1	0.64	8.3 . . . 8.3	

The planetary nebula, DREYER 6781, has the same R. A., and is 12′ north.

β 1257. L. 37156.

R. A. 19h 30m 26s
Decl. + 10° 53′

1891.709	176°.4	3″.89	6.3 . . 13.0	36
.711	174.0	3.65	7.0 . . 13.5	36
.731	176.0	3.61	7.0 . . 13.0	36
1891.72	175.5	3.72	6.8 . . 13.2	

Magnitude in D.M., 6.8.

β 1258. D.M. (29°) 3838.

R. A. 19h 55m 26s
Decl. + 29° 35′

1891.490	156°.2	1″.40	8.0 . . 11.0	12
.496	162.0	1.42	8.3 . . 11.5	12
.502	154.0	1.53	7.6 . . 10.0	36
1891.49	157.4	1.45	8.0 . . 10.8	

In attempting, in 1878, to measure β 439, which is near this place, I inadvertently measured another star, which is obviously this pair. That observation is:

1878.41	159°.9	1″.52	β	1 n

β 439 is 30s following this.

β 1259. W2 XX. 563.

R. A. 20h 16m 27s
Decl. + 30° 13′

1891.636	169°.5	0″.48	8.2 . . . 8.5	36
.652	173.1	0.44	8.3 . . . 8.7	36
.655	173.0	0.49	8.3 . . . 9.0	36
1891.65	171.9	0.47	8.3 . . . 8.7	

β 1260. D.M. (55°) 2368.

R. A. 20h 16m 39s
Decl. + 55° 19′

1891.540	170°.3	0″.42	8.0 . . 10.5	36
.578	165.7	0.49	8.3 . . 11.5	36
.594	172.2	0.50	8.4 . . 10.5	36
1891.57	169.4	0.47	8.2 . . 10.8	

This is 18′ north of Σ 2761.

β 1261. D.M. (15°) 4384.

R. A. $21^h\ 10^m\ 29^s$
Decl. $+\ 15°\ 35'$

1891.854	147°.0	1".65	8.5 . . 9.5	36
.856	152.2	1.81	8.5 . . 9.2	12
.859	147.5	1.71	8.4 . . 10.5	36
1891.85	148.9	1.72	8.5 . . 9.7	

This was discovered with the 18½-inch, at Chicago, in September, 1884, but not given in any of my catalogues of new pairs. The only other measures are:

1886.76	151°.5	1".39	Ho	2 n

β 1262. L. 41483.

R. A. $21^h\ 15^m\ 39^s$
Decl. $-\ 15°\ 26'$

1891.854	114°.3	1".82	8.3 . . . 9.3	36
.856	113.1	1.56	8.4 . . . 8.7	12
.859	112.6	1.99	8.3 . . . 8.9	36
1891.85	113.3	1.79	8.3 . . . 9.0	

This was found with the 6-inch, in 1873, in looking for H_1 N. 139. The place of that star is given by HERSCHEL II. as $21^h\ 12^m$; $+\ 15°\ 26'$. There is no pair in that vicinity, and it is possible that his place should be south declination, instead of north. This pair is inserted here to give it a number for future reference.

β 1263. L. 42381.

R. A. $21^h\ 38^m\ 40^s$
Decl. $+\ 2°\ 17'$

1891.594	214°.7	0".48	8.5 . . 10.0	36
.597	211.5	0.48	8.5 . . 10.5	36
.600	211.7	0.48	8.5 . . 10.0	36
1891.60	212.6	0.48	8.5 . . 10.2	

This is 4ˢ preceding, and 9'.6 south of β 689.

β 1264. L. 43933.

R. A. $22^h\ 24^m\ 1^s$
Decl. $-\ 0°\ 29'$

1891.673	21°.6	4".02	7.5 . . 13.0	36
.709	21.4	3.67	8.0 . . 13.5	36
.711	22.2	3.86	8.0 . . 13.5	36
1891.70	21.7	3.85	7.8 . . 13.3	

This is $1^m\ 24^s$ following *ζ Aquarii*, and 9 north.

β 1265. D.M. (60°) 2425.

R. A. $22^h\ 35^m\ 18^s$
Decl. $+\ 60°\ 47'$

B and C.

1891.575	250°.5	0".58	9.0 . . . 9.0	36
.578	253.2	0.55	9.0 . . . 9.1	36
.581	250.4	0.56	9.4 . . . 9.5	36
1891.58	251.4	0.56	9.1 . . . 9.2	

A and BC.

1891.575	346°.3	39".65	8.7 . . .	36
.578	346.4	39.70	8.8 . . .	36
.581	346.2	39.72	9.0 . . .	36
1891.58	346.3	39.69	8.8 . . .	

β 1266. D.M. (30°) 4963.

R. A. $23^h\ 24^m\ 29^s$
Decl. $+\ 30°\ 10'$

A and B.

1891.673	72°.1	0".24	7.5 . . . 7.5	36
.692	75.6	0.26	7.3 . . . 7.3	36
.709	74.2	0.23	7.5 . . . 7.5	36
1891.69	74.0	0.24	7.4 . . . 7.4	

AB and C (= Σ 3018).

1891.673	203°.7	19".00	. . . 9.5	36
.692	203.7	18.90	. . . 8.7	36
.709	203.0	18.86	. . . 8.8	36
1891.69	203.5	18.92	. . . 9.0	

There has been no change in the distant star since the first measures by STRUVE.

NINETEENTH CATALOGUE OF NEW DOUBLE STARS DISCOVERED AT THE LICK OBSERVATORY.

By S. W. Burnham.

The following are the results of my measures of double stars at Mount Hamilton from January, 1892, to June, when my connection with the Lick Observatory was permanently ended. These observations are not as extensive as I could have wished, but much of the time in the earlier part of the season the weather was unfavorable, and during the winter but little could be done.

Special attention has been given to double stars discovered by me for which we have no recent measures, and to pairs which are known to be in rapid motion. This was done for the purpose of giving as fully as possible the character of each pair in a General Catalogue, which I have prepared for publication, of all the double stars discovered by me from the beginning of my work. These stars have been published in various astronomical periodicals, in nineteen separate lists, and have become so inconvenient for reference that it seemed desirable to bring them all together in one catalogue, arranged in order of right ascension, and to give all the printed and unpublished observations of each pair.

The method of observing heretofore described has been followed in making the accompanying observations. Substantially all the measures have been made with the 36-inch telescope. The superiority of this instrument over any other for work of this kind has been fully demonstrated by a diligent use of it for nearly four years. During this time I have endeavored to make the most of every opportunity when it was at my disposal. I have wasted none of the time of the great telescope in merely looking at objects, and, consequently, very little of my own time in the way of descriptive writing. The micrometer has been in constant use, and I have endeavored to occupy a field which otherwise would be neglected, and as far as possible do that which could not be done elsewhere. The measures will speak for themselves, and their accuracy can be tested at any time hereafter.

β 1267. D.M. (30°) 942.

R. A. $5^h\ 27^m\ 22^s$
Decl. $+\ 30°\ 51'$

1892.118	217°.8	0″.83	8.5 . . . 8.5	36
.151	217.9	0.82	8.5 . . . 8.5	36
.153	218.0	0.87	8.5 . . . 8.5	36
1892.13	217.9	0.84	8.5 . . . 8.5	

This is in the immediate vicinity of ANDERSON'S new star in *Auriga*, and was discovered with the 36-inch in the course of a series of measures of the temporary star with reference to faint stars in the field with it. (*Monthly Notices*, April, 1892.) It is a very easy pair, and can be seen with a moderate aperture. This is L. 10423.

β 1268. 24 Monocerotis.

R. A. $7^h\ 9^m\ 11^s$
Decl. $+\ 0°\ 3'$

1892.189	313°.4	3″.75	6.0 . . 12.0	36
.192	312.9	3.88	6.0 . . 11.0	36
.227	312.8	3.81	6.0 . . 12.0	36
.230	313.7	3.80	6.0 . . 12.0	36
1892.21	313.2	3.81	6.0 . . 11.8	

This star is $O\Sigma$ 169, given as a close pair in the Poulkowa Catalogue of 1850. In 1847 $O\Sigma$ thought it was elongated in 199° on one night, and on another occasion it appeared to be single. In 1848 he thought there might be an elongation in 204°, and in 1851 it was doubtful. DEMBOWSKI, in 1867, suspected the disc to be wedged in 148°, and found it single in 1873. In 1873 I had a faint suspicion of a slight elongation in 310°, but in 1874 it was very doubtful. I examined it with the 36-inch, to settle, if possible, the doubt concerning the suspected duplicity. There was not the least trace of any elongation, and, if really double at all, it is certainly single now. The large telescope, however, showed a very minute attendant, which I have measured above. Of course this star has nothing to do with the close pair. It would hardly be seen with any of the telescopes with which this star has been previously examined.

β 1269. 44 Hydrae.

R. A. $10^h\ 28^m\ 18^s$
Decl. $-\ 23°\ 8'$

1892.230	63°.8	18″.33	5.0 . . 14.0	36

A very minute companion.

β 1270. L. 25825.

R. A. $13^h\ 57^m\ 46^s$
Decl. $+\ 9°\ 14'$

1892.189	330°.1	0″.28	8.0 . . . 8.0	36
.263	329.5	0.26	8.0 . . . 8.0	36
.364	329.4	0.28	8.5 . . . 8.7	36
1892.27	329.7	0.27	8.2 . . . 8.3	

β 1271. Radcliffe 3181.

R. A. $14^h\ 13^m\ 4^s$
Decl. $+\ 55°\ 6'$

1892.323	355°.1	2″.80	6.8 . . 11.5	36
.362	355.7	2.84	7.0 . . 12.0	36
.400	354.7	2.79	6.7 . . 12.5	36
1892.36	355.2	2.81	6.8 . . 12.0	

β 1272. O. Arg. N. 14451.

R. A. $14^h\ 13^m\ 21^s$
Decl. $+\ 49°\ 18'$

A and B.

1892.156	132°.3	1″.36	8.5 . . 9.5	36
.170	133.5	1.18	8.5 . . 10.0	36
.184	132.6	1.10	8.5 . . 9.0	12
.186	131.8	1.36	8.3 . . 9.5	36
1892.17	132.5	1.25	8.4 . . 9.5	

A and C (= H. 2710).

1892.156	321°.5	23″.51	. . . 8.5	36
.170	322.0	23.57	. . . 8.7	36
.184	322.2	24.02	. . . 8.5	12
.186	321.6	23.58	. . . 8.5	36
1892.17	321.8	23.67	. . . 8.6	

HERSCHEL gave the angle of C as 324°.0 in 1830, and the estimated distance, 25″. There are no measures since.

β 1273. O. Arg. N. 14457.

R. A. $14^h\ 14^m\ 2^s$
Decl. $+\ 48°\ 28'$

1892.156	196°.1	1".07	8.7 . .	9.5	36
.170	194.0	1.00	8.5 . .	9.5	36
.186	191.8	1.18	8.6 . .	10.5	36
1892.17	193.0	1.08	8.6 . .	9.8	

β 1274. B.A.C. 6216.

R. A. $18^h\ 12^m\ 35^s$
Decl. $+\ 56°\ 33'$

A and B.

1892.323	239°.2	95".76	6.0 . . .	36
.386	239.1	95.47	6.8 . . .	36
1892.35	239.1	95.61	6.4 . . .	

B and C.

1892.323	150°.9	0".77	9.5 . .	10.5	36
.386	146.1	0.93	10.0 . .	10.5	36
.403	144.4	0.94	10.0 . .	10.8	36
1892.37	147.1	0.88	9.8 . .	10.6	

B and D.

1892.323	8°.3	4".87		. . 10.0	36
.386	7.1	5.03		. . 10.5	36
.403	10.2	5.20		. . 10.6	36
1892.37	8.5	5.03		. . 10.4	

The distant double companion, BD, to the bright star was noted by me in 1878. The large telescope shows that one of these is a close pair.

ADDITIONAL NOTES.

ADDITIONAL NOTES.

Σ 2. (p. 15.)

GLASENAPP has recently determined the orbit of this pair (A. N. 3145), and finds the following elements:

$$P = 156.62 \text{ years.}$$
$$T = 1890.3$$
$$e = 0.40$$
$$a = 0''.55$$
$$i = 70°.2$$
$$\Omega = 154°.9$$
$$\lambda = 43°.9$$

It will be seen from the diagram I have given (*Knowledge*, March, 1891) of the measured positions of the components since 1830, that the arc is too small to obtain, with any certainty, the real orbit of this pair. The observations seem to point to a period much longer than that given above.

20 Persei. β 524. (p. 31.)

I have given the following apparent orbit of this rapid system in *Astronomy and Astro-Physics* for May, 1893 (Vol. XII., p. 404).

I have obtained by the graphical method the following elements:

$$P = 27.7 \text{ years.}$$
$$T = 1883.8$$
$$e = 0.475$$
$$a = 0''.237$$
$$i = 73°.6$$
$$\Omega = 132°.4$$
$$\lambda = 85°.5$$

Apparent Orbit.

Length of major axis	$= 0''.42$
Length of minor axis	$= 0''.13$
Angle of major axis	$= 131°.5$
Angle of periastron	$= 58°.0$
Distance of star from center	$= 0''.03$

Professor GLASENAPP has found substantially the same elements (*Astronomy and Astro-Physics*, Vol. XII., p. 499), by another method, from the same apparent ellipse.

95 Ceti. A.C. 2. (p. 33.)

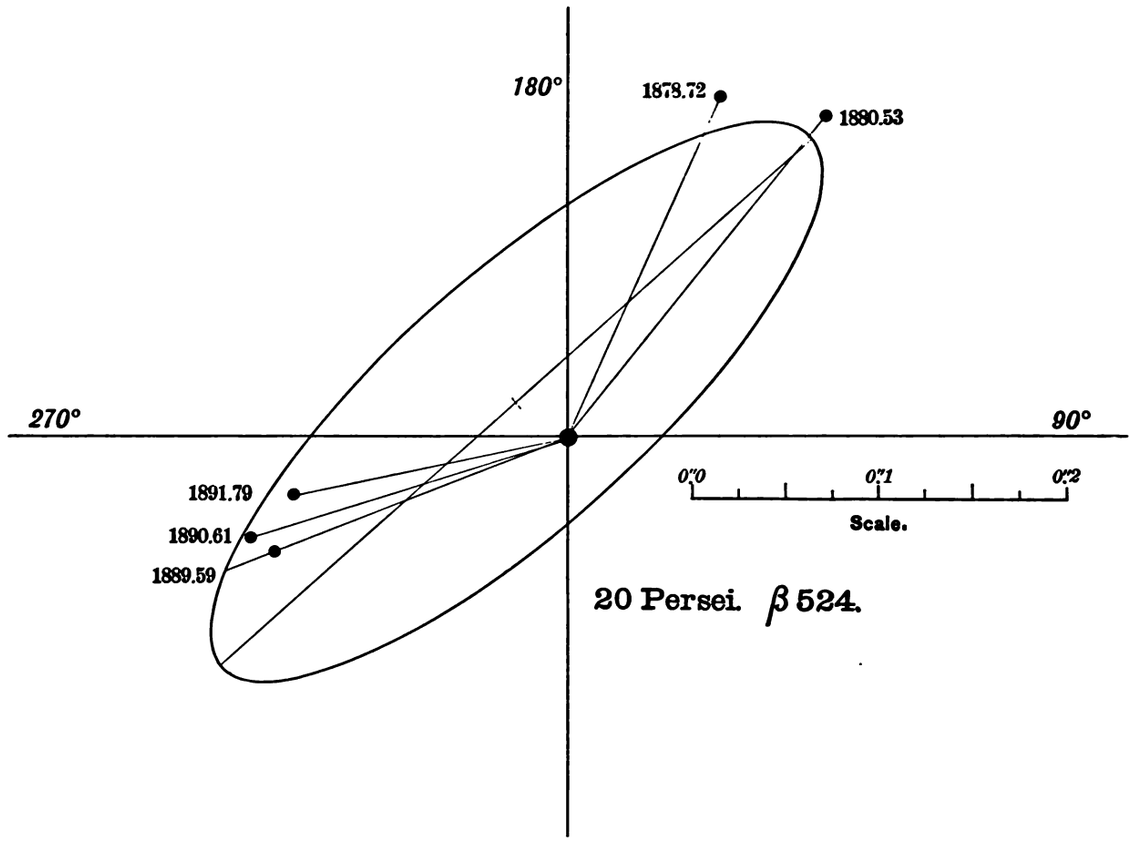
For a collection and discussion of all the measures of this pair, see *Astronomy and Astro-Physics* for October, 1893 (Vol. XII., p. 681).

40 Eridani. Σ 518. (p. 36.)

The double companion to 40 *Eridani* was discovered by HERSCHEL in 1783. It was next observed by STRUVE in 1825, but it was too difficult to measure. The measures of precision really commence with the observations of O. STRUVE in 1851. Since that time it has been looked after by the various double star observers, and the arc of nearly 60°, through which the small star has passed in the last forty years, is very well defined, and the measures as a whole appear to be fairly satisfactory. The mean angular change has been about one degree and a half per year, but it is obvious that the apparent ellipse is a very elongated one, and therefore the average motion for a complete revolution will be a much smaller quantity.

Though the period is long, this is an interesting binary from the large proper motion of the system. Only four stars in the northern hemisphere have a larger proper motion. This is common to the principal star, and to the binary companion, which is more than 80″ distant. HALL finds a parallax for A of 0″.22, so that the system is comparatively near the Earth.

The only orbit of BC is by GORE (*Monthly Notices*, 1886, March), who used the measures down to, and including, 1883. He found a period of 139.0 years. Since that time additional meas-



ures have been made, which are not well represented by the ellipse, and it is evident that this provisional orbit is not the best which can now be made.

I have collected from original sources all the observations, and give them in chronological order:

1	1783.13	326°.7	Cl. II.	1 n	Herschel
2	1825.12	287.0	. . .	1 n	Struve
3	1851.06	159.9	3″ ±	1 n	Dawes
	.22	155.8	3.91	4 n	O. Struve
4	1855.06	154.0	4.14	6 n	O. Struve
5	1864.85	147.6	4.45	2 n	Winnecke
6	1865.90	144.0	4.26	2 n	O. Struve
7	1869.10	140.4	4.46	1 n	O. Struve
8	1873.85	137.0	4.27	4 n	O. Struve
9	1877.84	128.2	3.92	6 n	Burnham
	.84	127.5	3.36	3 n	Cincinnati
	.95	126.4	3.94	4 n	Dembowski
10	1879.05	125.4	3.49	4 n	Burnham
	.11	122.9	. . .	1 n	Cincinnati
	.18	125.0	3.51	2 n	Hall
11	1879.75	120°.0	3″.29	1 n	Cincinnati
	80.09	121.3	3.28	5 n	Burnham
	80.95	122.0	3.16	5 n	Burnham
12	1881.84	119.0	3.53	6 n	Burnham
	2.12	118.1	3.24	2 n	Hall
13	1883.00	119.2	3.07	2 n	Burnham
14	1883.80	115.8	3.10	2 n	Hall
15	1886.00	112.2	3.22	2 n	Leavenworth
	.09	112.2	3.00	6 n	Hall
	.92	111.0	3.01	3 n	Tarrant
16	1888.12	107.7	3.04	5 n	Hall
17	1888.84	106.8	2.94	3 n	Burnham
	8.87	105.0	2.81	3 n	Tarrant
	9.12	103.5	2.79	4 n	Hall
18	1890.73	100.0	2.68	4 n	Burnham
	1.05	98.5	2.65	5 n	Hall
19	1891.78	97.4	2.48	4 n	Burnham

The two angles of HERSCHEL and STRUVE, and the seventeen positions derived from the measures, as shown above, are accurately laid down on the diagram. When more than one set of measures is used, as indicated by the brackets and corresponding marginal numbers, a simple mean is taken.

Now it is obvious that it is impossible to obtain by any method the real or apparent orbit of this pair from an arc of only 60°. A great variety of ellipses could be made which would represent these positions equally well, and which would differ widely from each other in every element. The angles of HERSCHEL and STRUVE are the only means we have of deciding upon the particular form of ellipse which shall be taken to represent the orbit. In doing this it is necessary to carefully weigh the probable relative values of these angles, because it is certain that if we put all of the observations on the same footing, and distribute the errors as equally as possible over the later accurate measures and the somewhat uncertain early angles, the result will not be reliable.

In 1783, when HERSCHEL discovered this pair, it must have been a very easy object, as from the estimated distance he placed it in Class II. (4″ to 8″). He appears to have made only a single measure of the angle, but in a pair as wide as this, that should give it within a few degrees at most of the true value, even from a rough setting of the wires. Therefore, we may assume that the distance was not less than 4″, and that the angle was not far from 326°. It is unfortunate that he did not make some attempt to measure the distance. Even a careful estimate at that time would be of great value now, since the errors of estimation should not much exceed 1″ in a pair of this kind.

In the position for 1825 there is much more uncertainty. This is about the only star of the class in STRUVE'S *Mensuræ Micrometricæ* which he was unable to measure. It is not given in its proper place as a close pair in this work. It is mentioned in the section where the distant star is treated (p. 275), and again in that part of the introduction which relates to proper motion (p. cxi). It must have been seen with extreme difficulty, as otherwise it would have been observed in the usual way, and given its proper place under his Class II. in the catalogue. The angle which he gives seems to have been regarded heretofore as some sort of measure, since one would hardly attempt to estimate a position-angle, even of the easiest pair of stars, so closely as to give it 287°. When we examine *Mensuræ Micrometricæ* carefully the explanation is very obvious. We find that this angle not only does not purport to be from a measure, but is not even an independent estimate. At this time STRUVE measured the angle of B from the large star, and obtained 107°. He evidently regarded C as being very nearly in line with AB, and consequently called the angle 287°. Therefore, I think that all we are justified in inferring from this observation is that in 1825 the companion was somewhere on the preceding side, and that the pair was close, and excessively difficult with the Dorpat telescope.

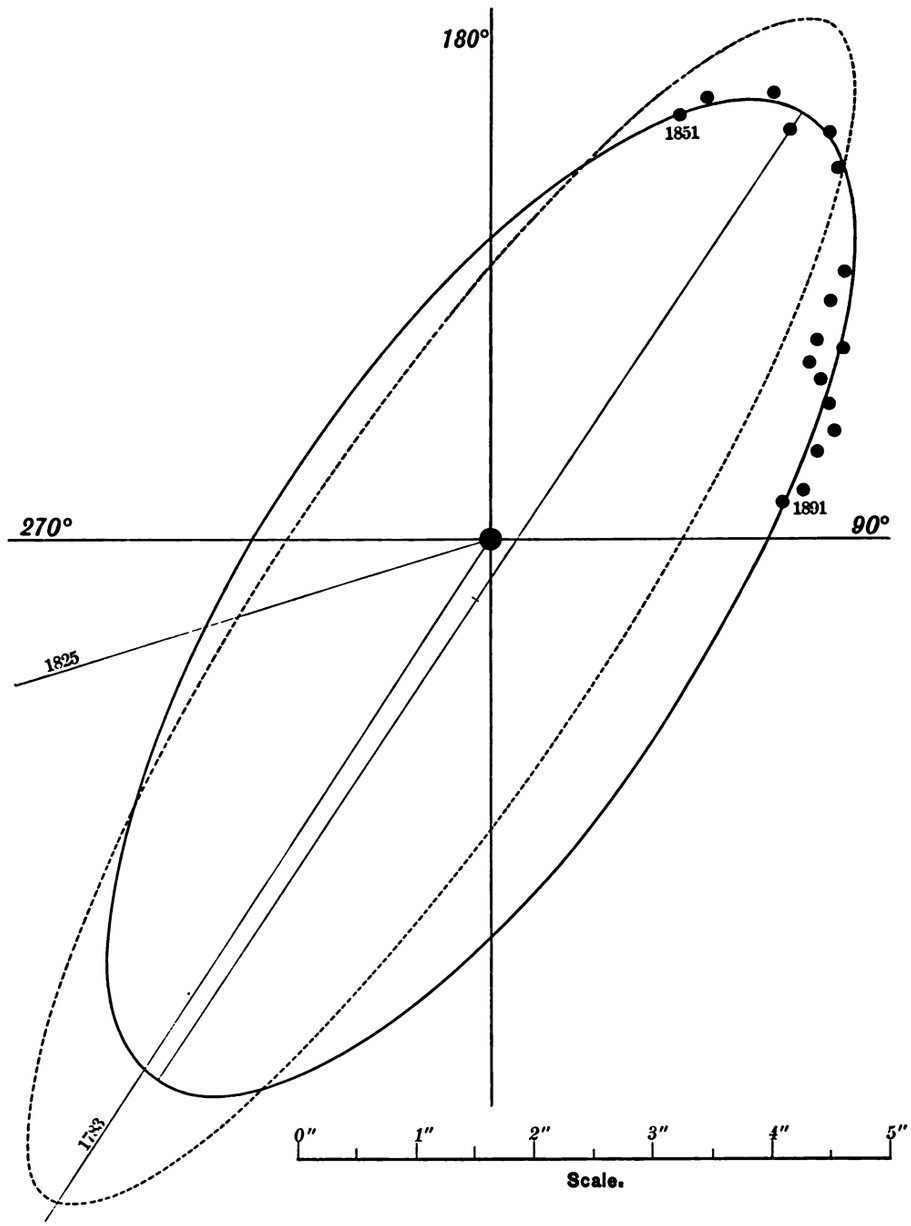
In drawing the ellipse to represent the apparent orbit there are two conditions to be met. First, it must represent as accurately as possible the observed positions from 1851 to 1892, and in this respect nothing must be sacrificed to make it conform to the earlier position-angles; and, secondly, the eccentricity and the length and direction of the major axis must be such that the areas of 1783 to 1851, and 1851 to 1892 are, as nearly as possible, proportional to the times. The uncertainty of the angle of 1825 is so great, it should not be used in determining the form of the ellipse. The result is far more likely to be correct when the other observations are depended upon.

GORE'S orbit is shown on the diagram by the dotted ellipse. He has evidently made it conform to STRUVE'S angle in 1825, since the error of that angle is only 5°.3; but in doing so it was necessary to sacrifice to some extent the measured positions of 1851 to 1883. It is obvious that this ellipse does not represent the distances at all satisfactorily. Ten of the distance measures require corrections of from 0″.70 to 0″.93. It would seem that measures by these observers, of a pair of this kind, should not have these large errors.

With the considerations in view which I have mentioned, I have drawn, after repeated trials, the ellipse shown on the diagram. It will be seen that it represents well all of the measured positions. The variations in distance are certainly not larger than the probable errors of the best observers, and the angles are correspondingly accurate.

In the following table will be found the corrections to be applied to the observed distances. These values will not be sensibly affected by the small changes in the angles:

1851.22	0.00	1865.90	+ 0.15
1855.06	— 0.10	1869.10	— 0.07
1864.85	— 0.10	1873.85	+ 0.03



40 Eridani. Σ 518.

1877.88	+ 20.″0	1886.34	— 0.″08
1879.11	+ 80.0	1888.12	— 0.22
1880.26	+ 0.24	1888.94	— 0.12
1881.98	— 0.03	1890.89	— 0.10
1883.00	+ 0.30	1891.78	0.00
1883.80	+ 0.08		

According to this orbit the angle at the time of HERSCHEL'S observation in 1783 was 324°.8, and the distance 5″.35. At the date of STRUVE'S examination the angle would be 244°.7, and the distance 1″.70. Under the circumstances this variation in the angle is not surprising. If the small star had been seen with any certainty, it

would have been measured like other difficult pairs in the *Mensuræ Micrometricæ*.

From this ellipse we get the following elements:

$P = 179.7$ years.
$T = 1843.7$
$e = 0.142$
$a = 6''.25$
$i = 69°.4$
$\Omega = 146°.2$
$\lambda = 313°.9$

Apparent Orbit.

Length of major axis	$= 9''.80$
Length of minor axis	$= 3''.77$
Angle of major axis	$= 146°.2$
Angle of periastron	$= 166°.7$
Distance of star from center	$= 0''.53$

According to this orbit the distance will slowly diminish until it is little more than 2″, and then gradually increase again until the maximum of nearly 5″.4 is reached, when one complete revolution will have been described since the observation of HERSCHEL. It happens that he discovered this pair when the distance was the greatest, and STRUVE observed it when the distance was minimum. The angular motion should steadily increase for some years. (*Monthly Notices*, LIII., 478.)

Sirius. (p. 54.)

The elements of the orbit of *Sirius*, derived from the apparent ellipse given on page 59, are as follows:

$P = 51.97$ years.
$T = 1893.5$
$e = 0.568$
$a = 8''.31$
$i = 50°.8$
$\Omega = 40°.3$
$\lambda = 135°.4$

The paper by AUWERS, referred to in the note on page 60, will be found in A. N. 3084.

9 Argus. β 101. (p. 64.)

This close pair was discovered with the 6-inch refractor in 1873. The attention of Baron DEMBOWSKI was called to it, and in 1875 it was measured by that distinguished observer. It was evident in the course of a very few years that it was a binary in rapid movement. Since that time the angular motion has been nearly 180°. For some years it has been a difficult pair to measure, and at the time of my last observations in 1892, it was a hard star with the 36-inch.

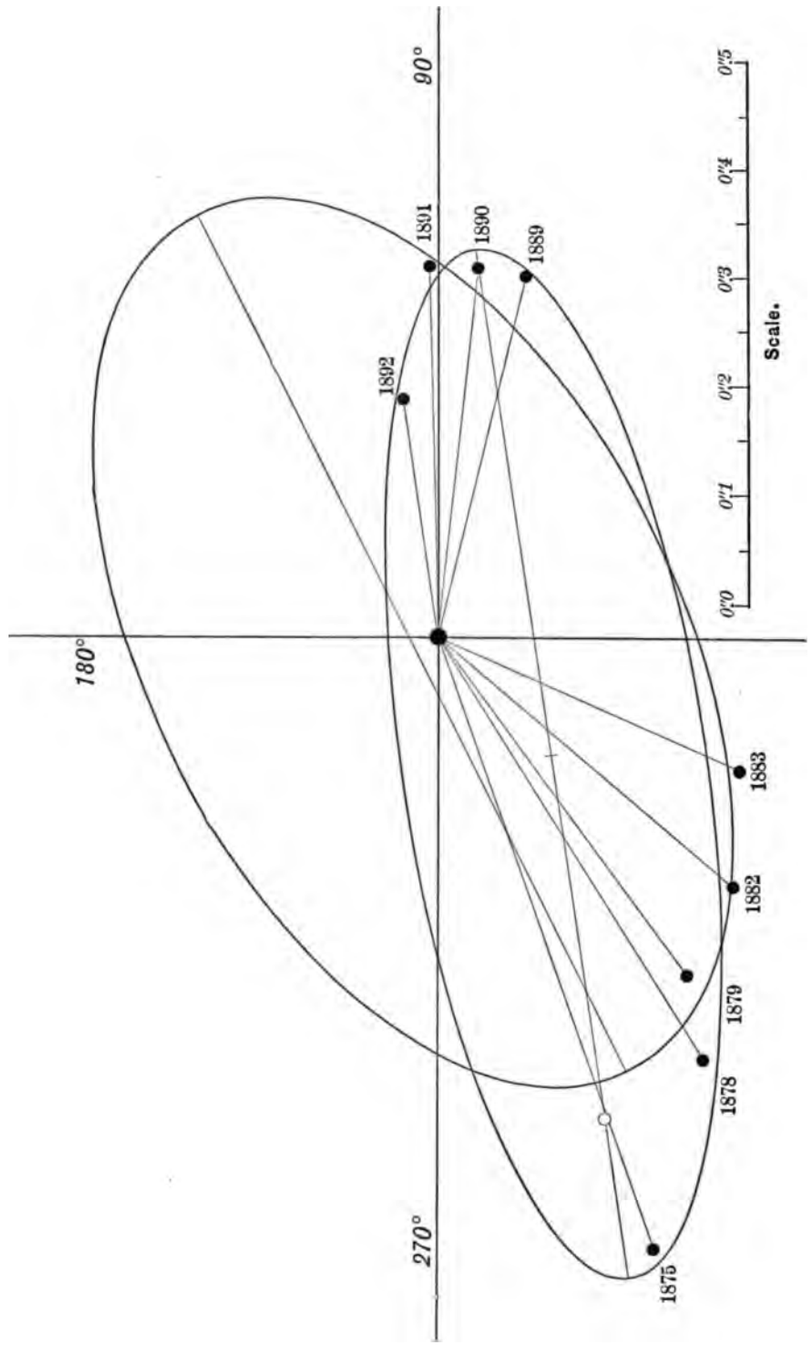
Last year Professor GLASENAPP computed the orbit of this pair (*Monthly Notices*, June, 1892), using my last measures at Mount Hamilton, and found a period of 40.54 years. This orbit represented all the measures very satisfactorily, with the single exception of the distance in the last measures of 1892. I found the distance to be 0″.22, and the orbit required that the distance at this time should be 0″.38. The largest error in the other observed distances was only 0″.07. The measures of 1889–91 did not show any diminution in the distance, and it would be very natural for any one but the observer to assume that the measured distance in 1892 was too small, and that it should be made to conform to the previous observations. But having made these measures on three different nights, and having looked at the star on several other occasions when it was too difficult with the then conditions to be well measured, I am able to say with confidence that my distance is substantially correct, and certainly not sensibly too large. One could not possibly make an error of 0″.16 in estimating, without the use of the micrometer at all, a distance of 0″.22. The error of estimation in such a pair ought not to much exceed 0″.05, where the observer has had considerable experience in this kind of work. I feel confident that at this time the distance of the components was not greater than 0″.25.

If this is the fact, it is obvious that GLASENAPP'S ellipse is incorrect, notwithstanding it represents all the other measures very perfectly, and that his period is much too long.

He has used the following measures:

1875.71	289°.4	0″.46	3 n	Δ
1878.50	302.2	0.45	4 n	Cin—β
1879.68	306.2	0.38	2 n	Hl
1882.21	319.7	0.35	4 n	Sp
1883.11	336.2	0.30	1 n	β
1889.08	76.4	0.34	4 n	β
1890.22	83.8	0.34	6 n	β—Sp
1891.06	91.5	0.34	4 n	β—Sp
1892.05	98.7	0.22	3 n	β

GLASENAPP'S orbit is shown by the large ellipse on the accompanying diagram, and the nine ob-



9 Argus. β 101.

served positions given above are accurately laid down to scale. It will be seen that this ellipse represents all the measures except the last, where the measured distance appears to be altogether wrong. As I have already said, I have every confidence in the substantial accuracy of this result, as well from the appearance of the star, which is perfectly remembered at this time, as from the micrometrical measures themselves. I have therefore endeavored to ascertain whether

some other ellipse could not be found which would represent the measures of 1892 equally as well as those made previous to that time.

Referring to my Second Catalogue of New Double Stars (*Monthly Notices*, May, 1873), where this pair was first published, it will be seen that the estimated distance is given 0″.7, and the angle 120° (300°), the components being considered of equal magnitude. I have not been able to consult my original observing book of that date, but I find in the *Astronomical Register* for June, 1873, an article on this star written by me, in which it is stated, "the distance I estimate from 0″.5 to 0″.7." I think it is safe to assume that the probable error of the estimate would place the star not far from this mean. In this connection I may mention that in a later number of the same journal (*Astronomical Register*, February, 1876), I gave the result of a comparison of all my estimates of the distances of double stars discovered by me down to that time, with the subsequent measures of DEMBOWSKI, and from this it appeared that in estimating the distance of pairs where it did not exceed 1″, and, of course, many of them would be less than 0″.5, the mean error was 0″.11. Therefore, I think we may say that the real distance of 9 *Argus* at the time of discovery was about 0″.6.

For the purpose of getting all the information possible concerning the relative position of the components in the earlier part of the observed revolution, it is desirable to examine critically the first measures that were made. We find the following individual measures by DEMBOWSKI, with the mean result which he adopted:

	°	″
1875.244	289.6	Cuneata
75.249	289.9	0.58
76.071	(314.0)	0.35 a piu
76.263	288.8	0.44 cuneo
1875.71	289.4	0.46

This mean is used by GLASENAPP in his orbit. Now, it is clear that in a rapidly moving pair like this, observations in different years should not be combined unless for exceptional reasons, and that the two positions in 1875 should stand by themselves. From all the evidence it would seem that the measured distance of 0″.58 was probably about right, and I have therefore adopted the mean of these two measures:

1875.24 P = 289°.7 D = 0″.58

The angles in 1876 differ so much that no use can be made of them. A mean cannot be used where the discrepancy is so large, and the only safe way is to reject them altogether.

We have now additional data for a new apparent orbit, which will necessarily be wholly unlike the large ellipse. The new position from DEMBOWSKI'S measures in 1875, given above, is laid down on the diagram, and all of the measures used are represented by dark circles. The position from the mean of all DEMBOWSKI'S observations, which is now rejected, is shown by the white circle.

The ellipse shown on the diagram was then carefully drawn to represent in the best possible way all of these observed positions, and make the areas proportional to the times. How successfully this has been done will be seen from the following corrections, which have to be applied to the observations to make them conform to this orbit:

	°	″
1875.24	0.0	+ 0.01
1878.50	— 1.7	+ 0.04
1879.68	— 0.5	+ 0.05
1882.21	+ 5.0	— 0.04
1883.11	0.0	— 0.04
1889.08	— 3.8	— 0.01
1890.22	— 1.8	+ 0.02
1891.06	— 2.7	0.00
1892.05	0.0	+ 0.02

From this ellipse we get directly the following elements:

$P = 23.3$ years.
$T = 1892.7$
$e = 0.68$
$a = 0''.61$
$i = 76°.6$
$\Omega = 95°.6$
$\lambda = 73°.6$

Apparent Orbit.

Length of major axis	= 0″.937
Length of minor axis	= 0″.275
Angle of major axis	= 98°.7
Angle of periastron	= 133°.8
Distance of star from center	= 0″.15

According to this orbit, the position-angle at the time of discovery (1873.19) was 283°.5, and the distance 0″.58. This agrees well with my estimates at that time; and all the subsequent

measures, including the last observations at Mount Hamilton, are satisfactorily represented.

We have not long to wait to determine whether or not this orbit is generally accurate. The enormous angular velocity from the date of the last measures, should, in the two years following that time, carry the companion over an arc of about 180°, so that when this pair can be observed again at the beginning of 1894, the position-angle should be a little more than 270°, and the distance about 0″.35. This will make it easily measurable with ordinary telescopes, and it can then be determined at once what, if any, corrections are necessary in this ellipse.

Dr. SEE has computed the elements by the method of KLINKERFUES from the same apparent ellipse (*Astronomy and Astro-Physics*, XII., 499), and obtained substantially the same result.

[I requested Prof. BARNARD to measure this pair this year (1893), and since the foregoing was in type I have received from him three observations giving 282°.1 : 0″.44 (1893.94). This shows an angular motion of more than 180° since my measures in 1892, and that the orbit given above is substantially correct.]

ζ Cancri. Σ 1196. (p. 66.)

For an examination and discussion of the observations which have been used in support of the theory of a fourth and dark star in the system of ζ *Cancri*, the reader is referred to the following papers on this subject:

BURNHAM, *Monthly Notices*, LI., 390; LIII., 40.
SEELIGER, *Astronomische Nachrichten*, 3051, 3165.
BURNHAM, *Astronomy and Astro-Physics*, Dec., 1893.

φ Ursæ Majoris. OΣ 208. (p. 70.)

GLASENAPP has computed the elements of this pair (A. N. 3119), and finds:

P = 91.92 years.
T = 1885.37
e = 0.453
a = 0″.294
i = 34°.7
☊ = 165°.7
λ = 19°.0

OΣ 224. (p. 72.)

GLASENAPP has recently computed an orbit of this pair (*Astronomy and Astro-Physics*, October, 1893), and finds a period of 223.7 years.

OΣ 269. (p. 79.)

Since the graphical orbit referred to (*Observatory*, July, 1891) was published, another orbit has been computed by GORE (*Monthly Notices*, June, 1892).

The following are the elements of these orbits:

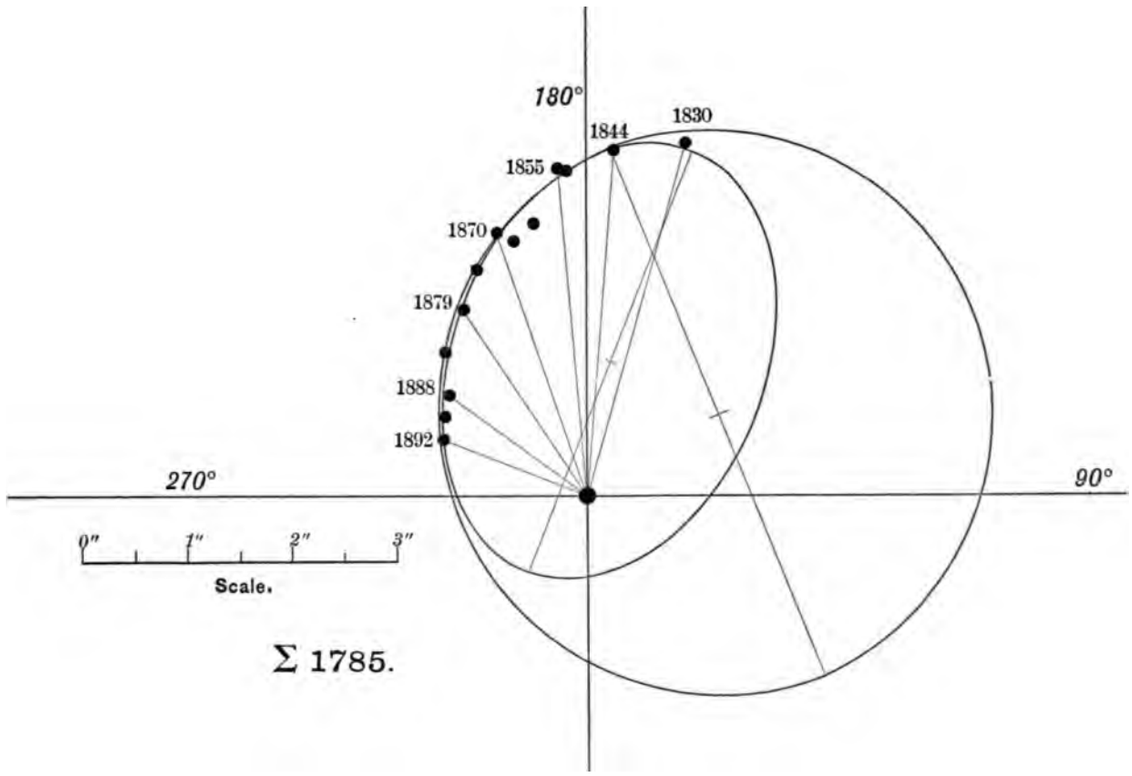
	Burnham.	Gore.
P =	48.4 years.	47.7 years.
T =	1883.4	1883.12
e =	0.38	0.057
a =	0″.36	0″.58
i =	71°.2	82°.8
☊ =	50°.8	51°.9
λ =	29°.9	43°.5

It will be noted that these orbits, though apparently similar in some respects, differ very greatly in the eccentricity, the one by GORE being practically circular, while the other has nearly the average eccentricity, as shown by Dr. SEE, of all the known binary systems.

Σ 1785. (p. 80.)

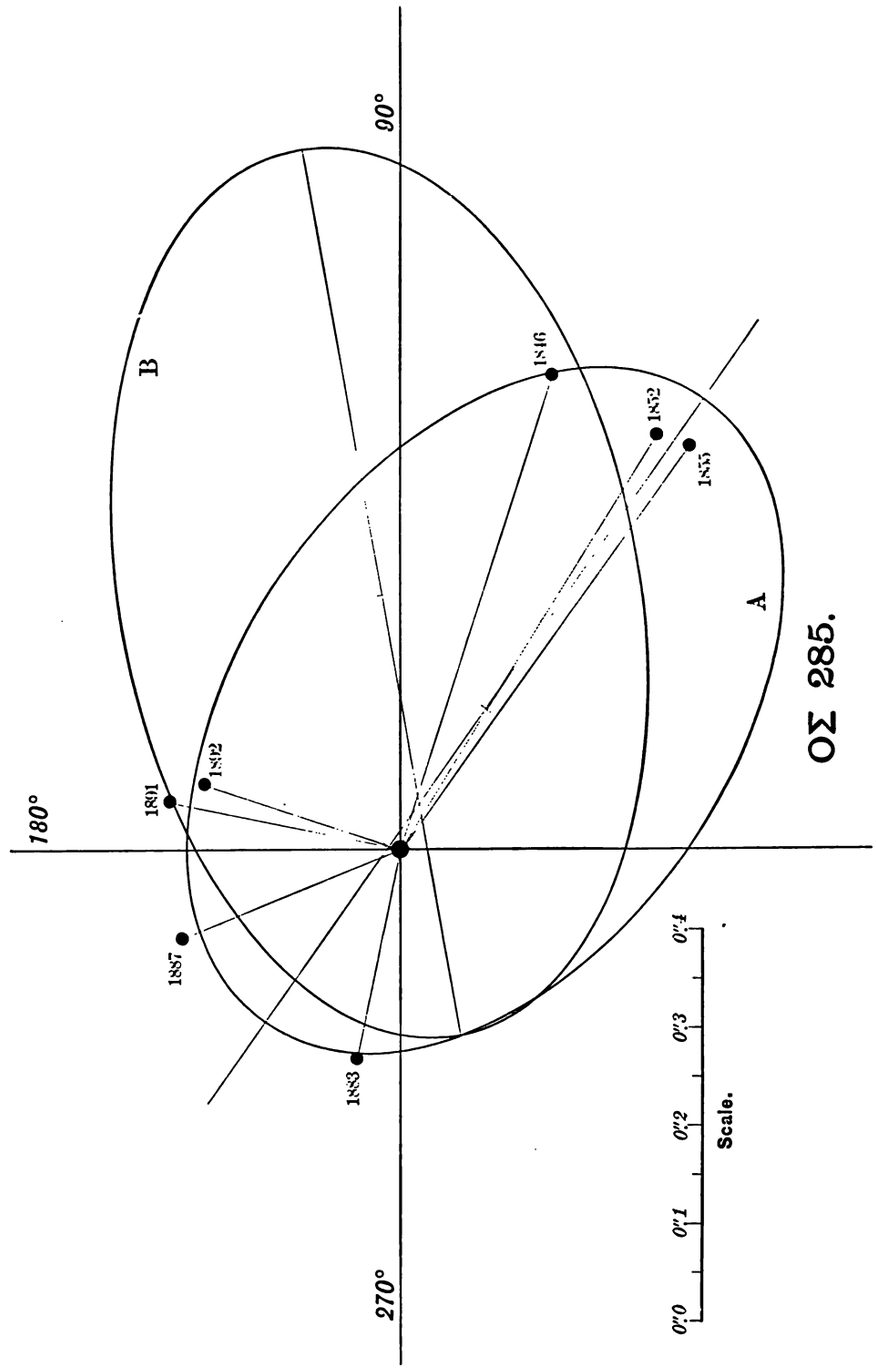
In a paper on this star, printed in *Monthly Notices*, Royal Astronomical Society, for December, 1892, I have given a complete list of the micrometrical measures of this pair from the first observations of SOUTH in 1823 to the last measures in 1892, made with the 36-inch at Mount Hamilton; and also a diagram drawn to scale, showing the relative positions of the components at these various epochs. The arc of the apparent orbit passed over during the sixty years covered by the observations is about 84°. Some of the early measures are very discordant in distance, and so obviously erroneous that it is necessary to reject them altogether in making any investigation of the real orbit. I have recently examined these measures more carefully with a view of ascertaining the periodic time, or within what limits it is likely to be. (*Astronomy and Astro-Physics*, May, 1893.) I have used, as heretofore, the graphical method.

The accompanying diagram gives the results



of this examination. I have used selected mean results at convenient intervals as shown, which are laid down accurately to scale. The smaller ellipse was then drawn to satisfy equal areas in equal times as accurately as possible. This ellipse gives a period of about 130 years, and an eccentricity of the real ellipse of 0.63, with periastron passage in 1906. It was apparent that with the length of arc described, many other and much larger ellipses could be drawn, which would equally well satisfy the observations, and, so far as one can tell at this time, give periods as likely to be correct. The larger ellipse was then drawn, and it represents the measures throughout exactly as well as the other. There is no appreciable difference between them in this regard, except as to the measures of STRUVE in 1830, and the difference there is only 0″.11. This is not only an insensible quantity in such a distance, but far below the probable error of his measures. In fact, his measures of this pair range in distance from 3″.32 to 3″.57, the mean being 3″.487. If any weight were to be given to the other measures of that time, SOUTH 5″.66 (1823.40), HERSCHEL 4″.62 (1830.20), and HERSCHEL 7″.69 (1831.34), the distance of the companion as given by the larger ellipse is still much too small, and consequently the ellipse itself. These measures, however, should not be used for any purpose, and it is far better to rely wholly on the observations of STRUVE.

The second ellipse gives a period of a little over 300 years. The eccentricity of the real ellipse, of which this is a projection, is 0.56, differing in that respect but little from the other. It is probable that the first ellipse could have been made a little smaller, so that it appears to be safe to say that the period of this pair is somewhere between 120 and 300 years, and that until a longer arc has been passed over, it will be impossible to say with any certainty what the real time is. For the next ten years the two ellipses are practically coincident, and the measures will not show the extent of the apparent orbit, but the observations of the succeeding decade should be sufficient to confine the error of the periodic time within narrow limits. This will always be an easy pair to measure, for with

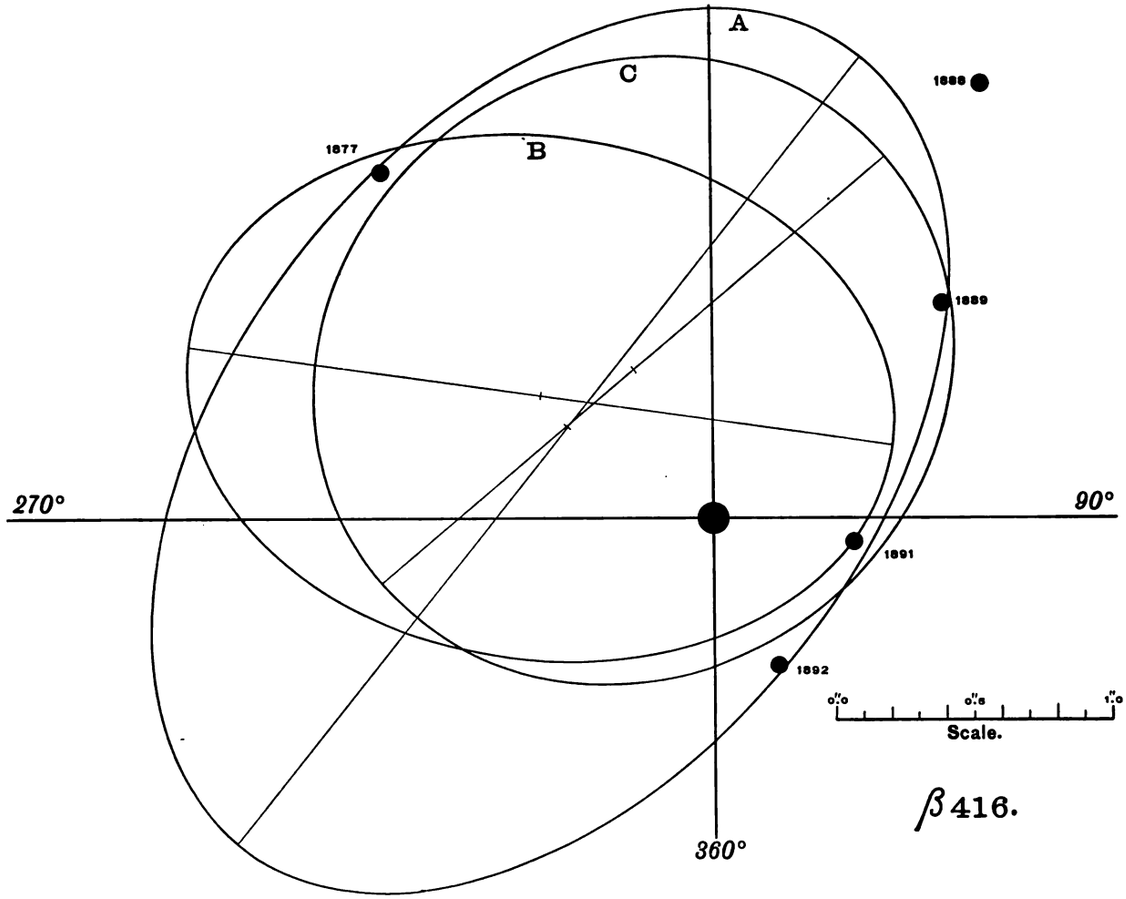


the shortest time the minimum distance will not be less than 0".6, and may be as much as 1".

Mr. Gore has computed a provisional orbit (*Monthly Notices*, LIII., 333), adopting one of the smallest apparent ellipses to represent the measures, and finds a period of 125.52 years.

OΣ 285. (p. 83.)

In the *Sidereal Messenger* for June, 1891, I gave the apparent orbit of *OΣ* 285, with a list of the measures down to that time upon which it was based. From this I deduced the period, but



β 416.

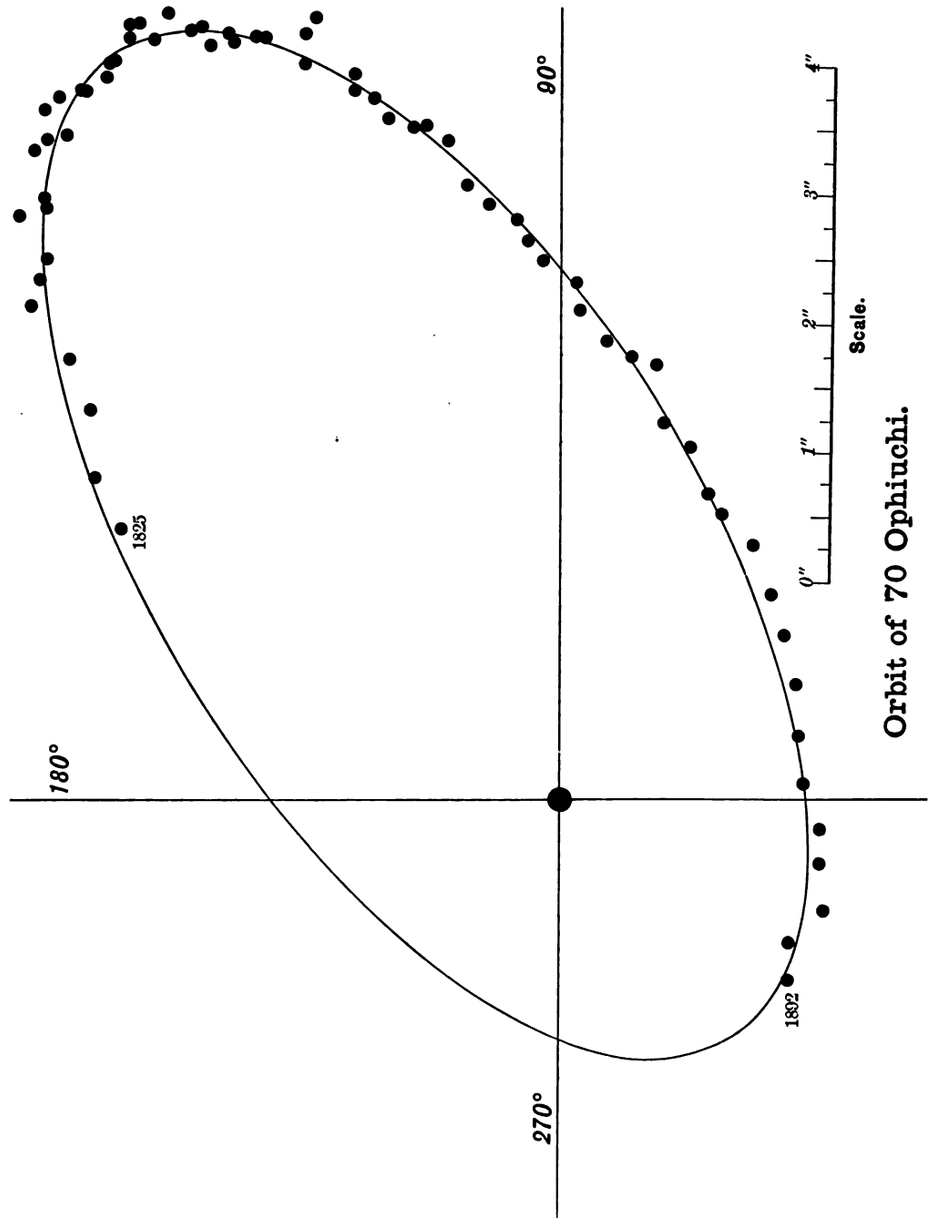
by a clerical error it is printed in the paper referred to as 72.7 years instead of 62.7. The other elements of the real orbit were not given.

Mr. GORE has recently published a new orbit of this pair in *Monthly Notices*, Royal Astronomical Society, for April, 1893, which differs in every material respect from the previous orbit. It is a good example of totally dissimilar results being derived from precisely the same data. It seems to me that the measures are better represented by the first ellipse; but, however that may be, it will be of some interest now, and more hereafter, to show on the same diagram the two orbits. I have carefully gone over my original diagram, and as I see no reason for changing it in any respect, it is reproduced exactly as it was given, with the addition of the position derived from my measures at Mount Hamilton in 1892. This orbit is marked A. The ellipse B is that found by GORE, using the same observations, including the last set of measures in 1892.

For a further comparison of the two, I have obtained from my orbit all the elements:

	Burnham.	Gore.
P	= 62.1 years.	118.57 years.
T	= 1885.3	1881.93
e	= 0.429	0.58
a	= 0″.387	0″.46
i	= 44°.3	45°.7
Ω	= 54°.3	107°.0
λ	= 180°.0	161°.4

If the second orbit is correct, this will soon be an easy pair to measure, and it is probable that the present year will show whether or not the distance is really increasing. According to my ellipse the distance between the components will not exceed 0″.25 for some years to come. Of course, in any event, the elements at this time are only provisional, but annual observations for the next three or four years should define the general form of the apparent orbit.



I have not given a comparison of the errors of the observations according to the respective orbits, as that sufficiently appears from an inspection of the diagram.

NOTE.—After the foregoing was written, I had an opportunity, in company with Professor HOUGH, of examining this pair on June 16th, with the 18½-inch refractor of the DEARBORN Observatory. It appeared certain from inspection that no sensible change in the distance had taken place since my measures at Mount Hamilton in 1891 and 1892. It is a rather difficult pair with the DEARBORN telescope, but I made on this occasion what seemed to be a fairly good measure, and obtained 156°.0 for the position-angle, and 0″.24 for the distance. This would seem to indicate that the distance is not increasing, and that the shorter period is more likely to be correct. (*Astronomy and Astro-Physics*, August, 1893.)

Scorpii 185. β 416. (p. 93.)

After the measures of 1892 were made, I obtained the orbit by the graphical method from all the measures, the angular motion then being about 200°. Since that time two other orbits have been computed, one by GORE (*Monthly Notices*, March, 1893), and the other by GLASENAPP (*Astronomy and Astro-Physics*, May, 1893). These are marked respectively A and B on the accompanying diagram.

As these several investigations give very different results in the elements of the orbits, and in the apparent ellipses which represent the path of the companion, and as all have used precisely the same data, it will be interesting at this time to examine them as laid down on the same sheet. It will be seen that the measures have been differently treated in the adjustment of the angles and distances. To some extent this may be explained by the methods employed.

The following are the elements of the respective orbits:

	Gore. A	Glasenapp. B	Burnham. C
P =	34.48 years.	34.85 years.	24.7 years.
T =	1891.85	1892.00	1892.26
e =	0.556	0.65	0.56
a =	2″.13	1″.52	1″.46
i =	56°.7	45°.4	44°.4
Ω =	139°.4	104°.3	122°.0
λ =	278°.2	300°.7	93°.5

70 Ophiuchi. Σ 2272. (p. 98.)

Having made a complete list of the measures of 70 *Ophiuchi*, I have taken occasion to get the elements of the orbit by the graphical method. How well the apparent ellipse represents the observations will be seen from the accompanying diagram. The positions given are for each year in which complete measures have been made. When measured by more than one observer, a simple mean is taken. The last measures shown are my observations at Mount Hamilton in 1892.

The following elements are derived from this ellipse:

P = 87.75 years.
T = 1895.6
e = 0.50
a = 4″.56
i = 58°.3
Ω = 123°.5
λ = 190°.8

Apparent Orbit.

Length of major axis	= 8″.97
Length of minor axis	= 4″.21
Angle of major axis	= 121°.6
Angle of periastron	= 117°.5
Distance of star from center	= 2″.23

The element λ is reckoned in the direction of the motion, in accordance with the plan adopted by Dr. SEE, to secure uniformity in this respect. This quantity would be 169°.2, if measured in the opposite direction, as has been done in some of the published orbits.

This is one of the few binaries where the period is fairly well known. The final result will probably not differ more than one year from that given here. This orbit is substantially identical with that found by GORE in 1888. Sixteen orbits of this system have been published, with periods varying from 73 to 98 years.

ζ Sagittarii. (p. 104.)

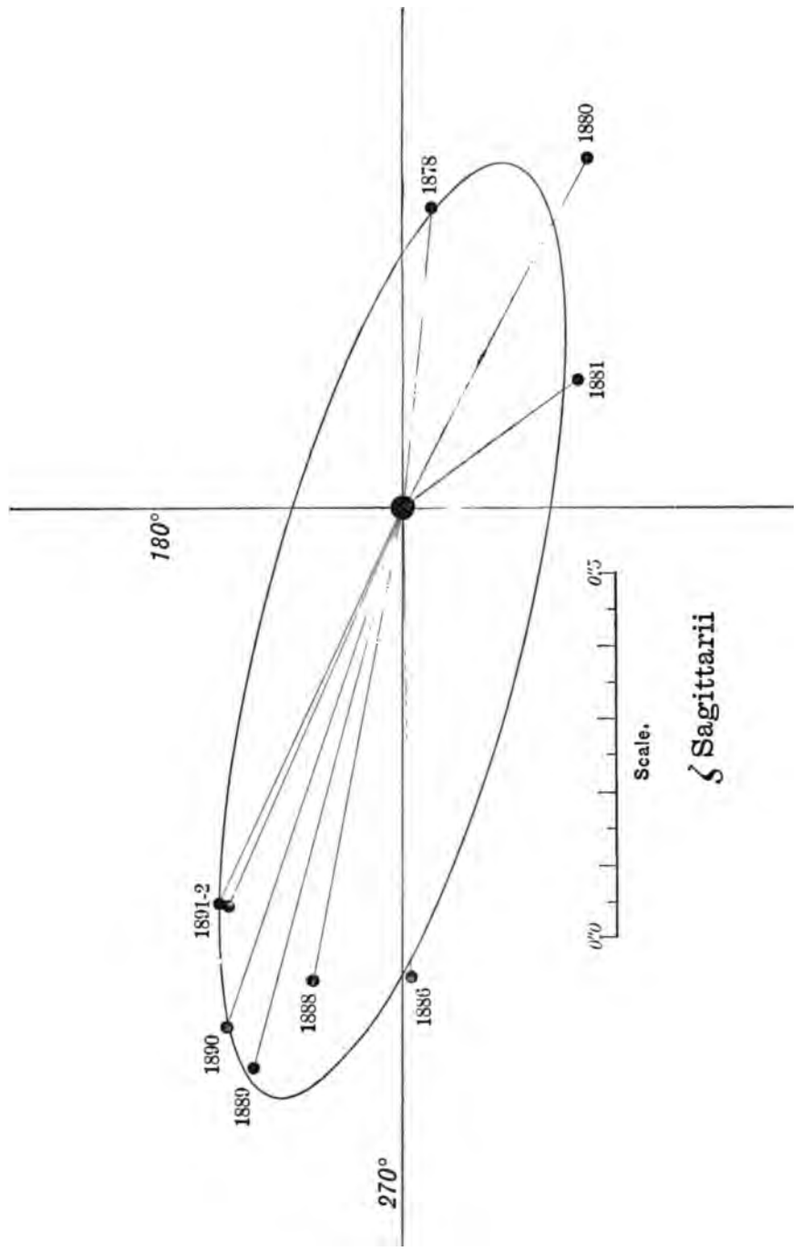
I have drawn the accompanying apparent orbit of this binary, from which Mr. J. W. FROLEY has computed the elements (paper by Dr. T. J. J. SEE, *Astronomy and Astro-Physics*, June, 1893), and obtained the following:

P = 17.71 years.
T = 1878.62
e = 0.30
a = 0″.68
i = 73°.95
Ω = 75°.35
λ = 327°.35

β Delphini. β 151. (p. 118.)

GLASENAPP has recently computed another orbit (A. N. 3177), and finds the following elements:

P = 22.97 years.
T = 1882.37
e = 0.26
a = 0″.50
i = 64°.1
Ω = 174°.2
λ = 343°.9



τ Cygni. A.G.C. 13. (p. 124.)

The companion to this star was discovered by ALVAN G. CLARK in 1874, October, with the 26-inch object glass, which was subsequently mounted at the MCCORMICK Observatory. At this time the new pair was not difficult, and it was measured on many nights in the few years following by DEMBOWSKI with an instrument of about seven inches aperture. His observations were the first to show that the small star was in motion, and they continued long enough to prove a change of about 30° in angle, with some diminution of the distance. It was soon evident that this was orbital motion. The large star was known to have a large proper motion, amounting annually to 0".484 in the direction of 17°.3, and

the measures showed that this belonged to the small star as well, and that they must form a physical system. The companion was also measured by other observers from time to time, but very little was done for some years following 1880. It had become a much closer and more difficult object, and like all similar pairs it was neglected by many observers with instruments sufficiently powerful to measure it properly.

When my work in this line commenced at the LICK Observatory, I placed this pair on the working list, and observed it regularly every year as long as I remained there. By this time the change in distance of the components had made it a rather difficult pair with the 36-inch, except under very favorable conditions.

GORE, in 1886, using the measures down to 1885, computed a provisional orbit of this pair, and found a period of 53.87 years (A. N. 2749). Some of the measures were discordant, and the arc was too small to give any very good result. When the later measures at Mount Hamilton were made, it was clear that the apparent orbit must be represented by a very different ellipse, and therefore special attention was given to measuring the companion with all possible care. The arc passed over is now nearly 180°, and with a sufficient number of reliable measures a good orbit should be made. The following are all the published measures of this pair, arranged in chronological order:

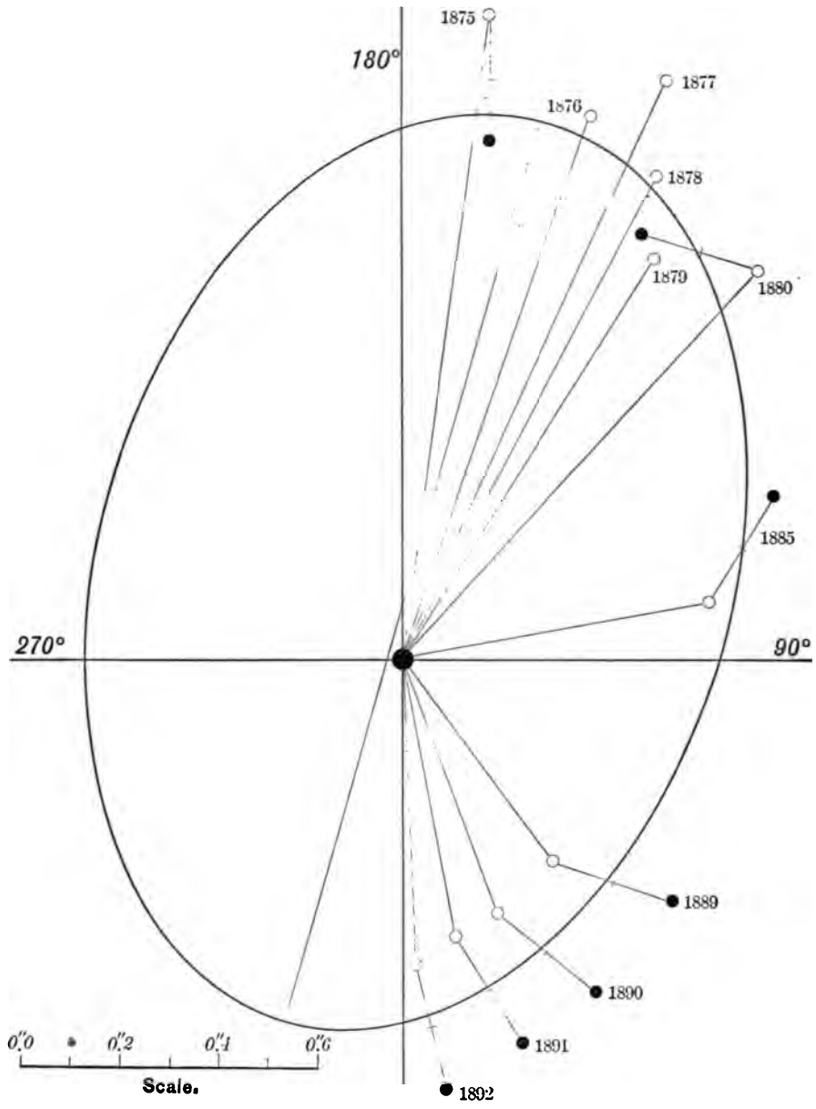
1874.89	162°.6	1".11	2 n	Newcomb
1875.12	174.5	1.24	2 n	Dembowski
1875.69	170.5	1.32	3 n	Dembowski
1876.79	161.5	1.24	2 n	Dembowski
1876.83	166.9	1.62	2 n	Waldo
1876.90	160.2	1.03	2 n	Hall
1877.70	155.3	1.26	8 n	Dembowski
1878.41	150.0	1.06	1 n	Burnham
1878.54	147.5	1.09	3 n	Dembowski
1878.76	158.8	1.09	2 n	Hall
1879.50	148.3	0.90	2 n	Burnham
1879.75	147.3	0.98	6 n	Hall
1880.77	137.4	1.04	1 n	Frisby
1883.88	159.2	...	3 n	Seabroke
1885.52	116.3	1.08	3 n	Tarrant
1885.73	100.7	0.62	1 n	Hall
1886.78	80. ±	0.5 ±	1 n	Hough
1887.76	56.4	0.4 ±	1 n	Hough
1889.49	36.5	0.50	4 n	Burnham
1890.54	20.5	0.54	3 n	Burnham
1891.49	12.4	0.61	3 n	Burnham
1891.69	9.3	0.52	3 n	Hall
1892.40	2.3	0.61	3 n	Burnham

It is obvious that some of these measures are of little value in an investigation of the relative motion, and that if any trustworthy conclusion is reached, it must be by rejecting doubtful and incomplete measures, and combining those made on a proper number of nights, and by the most experienced observers. Therefore, as a preliminary step to laying down the positions to scale, I have selected the following:

1875.46	172°.1	1".29	5 n	De
1876.85	160.8	1.14	4 n	De–Hl
1877.70	155.3	1.26	8 n	De
1878.57	152.1	1.08	6 n	De–Hl–β
1879.62	147.8	0.94	8 n	Hl–β
1880.77	137.4	1.04	1 n	F
1885.73	100.7	0.62	1 n	Hl
1889.49	36.5	0.50	4 n	β
1890.54	20.5	0.54	3 n	β
1891.59	10.8	0.56	6 n	Hl–β
1892.40	2.3	0.61	3 n	β

These observations are shown on the accompanying diagram, which is a photographic reduction of the large drawing, by the white circles connected by radial lines with the central star. An examination of these positions shows that the angular motion from 1875 to 1880 is too rapid when compared with the observed places 1889 to 1892; or the motion for the latter interval should be increased to make the areas described proportional to the times. The measures in the first interval are by the most experienced observers with the micrometer, and they are means of a sufficient number of nights to give presumably good results both in angle and distance. The last series of measures were made with the best telescope for the purpose in the world. I used every precaution to get good measures. They were made with a power of at least 1500, with favorable atmospheric conditions, and are consistent with each other. If we assume that the errors are uniformly distributed, which in cases of this kind is certainly not likely to be the fact, and that the angular motion and the distances are too large for the first interval, and correspondingly too small in the second, we find that the apparent ellipse which will satisfy the times requires corrections to the measures which are apparently inadmissible, and that it is necessary to wait for further measures in order to determine where the truth is.

There always remains in an example like this, where observations have some inconsistency when considered together, another method of treating them, which might be termed the heroic



τ Cygni.

treatment, by the introduction of another star which shall account for and explain the apparent anomalies. It is always easy to do this, since one is not hampered by any restrictions, and can assume anything to supply the apparent deficiency shown by the actual observations.

It is obvious from an inspection of the observed positions shown on the diagram what the general character of the supposed invisible star must be to harmonize the observations. Let us assume that the CLARK companion is attended by a "dark" sun of equal mass, the two revolving about the common center of gravity in an orbit whose plane is at right angles to the line of sight. For the revolution of these stars we may take 17.6 years, since this will answer the purpose as well as any other, and further assume that their apparent distance is a quarter of a second, the position-angle of the invisible star being zero at the date of the first measures, and the motion retrograde. Then for the dates of the respective measures the angles are as follows:

1875.46	P = 360.0°	1885.73	P = 150.0°
1876.85	331.6	1889.49	73.1
1877.70	314.1	1890.54	51.6
1878.57	296.4	1891.59	30.2
1879.62	274.9	1892.40	13.6
1880.77	251.4		

The positions of the dark star at the several dates are indicated on the diagram by dark circles connected by straight lines with the observed positions of the real star. These are omitted for the observations between 1875 and 1880 to avoid confusing the diagram. The distance between the two stars is 0".25, and, of course, the center of gravity is at the middle of the line joining the two circles.

The next step was to draw an ellipse as accurately as possible through the center of gravity at the various epochs, and after several trials the ellipse shown in the diagram was made. When this was examined, and the areas described by the line drawn from the principal star to the center of gravity of B and C compared with the corresponding times, a very satisfactory agreement was found. The following are the errors of the angles and distances:

	°	"
1875.46	0.0	— 0.07
1876.85	+ 2.5	+ 0.08
1877.70	+ 2.3	— 0.06
1878.57	— 0.4	+ 0.10
1879.62	— 4.0	+ 0.18
1880.77	0.0	0.00
1885.73	— 8.0	0.00
1889.49	— 2.7	0.00
1890.54	— 1.1	— 0.01
1891.59	+ 3.0	0.00
1892.40	— 3.1	— 0.03

Doubtless these errors could have been differently and possibly better distributed, but the variations are small, and will compare favorably with those of most of the computed orbits where the measures are easily made. This harmonizes all the measures in angle and distance, and whatever the probabilities may be as to the existence of a disturbing third body, they are at least as strong in this case as in any other instance where a similar assumption has been made. This ellipse also represents the observed positions of the known companion, leaving the third star out of the question, as well as any which can be drawn at this time, but it will be seen that the errors of the measures are very much larger in angle and distance, and certainly larger than they should be in first-class observations.

The following elements of the orbit are found from this ellipse:

$P = 36.5$ years.
$T = 1893.1$
$e = 0.24$
$a = 0''.94$
$i = 46°.7$
$\Omega = 163°.6$
$\lambda = 164°.9$

Apparent Orbit.

Length of major axis	= 1".86
Length of minor axis	= 1".26
Angle of major axis	= 164°.0
Angle of periastron	= 354°.0
Distance of star from center	= 0".17

An ephemeris for the visible companion star is easily made from the apparent orbit. The following are the angles and distances of the companion, according to this theory, as they should appear from the measures at these times:

	°	"
1893.40	350.0	0.62
1894.40	341.6	0.64
1895.40	332.3	0.64

Before treating this matter very seriously, I would suggest the propriety of waiting until additional observations are made. It may be that the third star can be dispensed with. In any case this pair should be carefully observed each year. A few good measures will be of more value than any amount of speculation. It is evident that the companion can be measured in every part of the orbit. In double star matters we can afford to wait longer for theories than for results with the micrometer. Nor will it do to place too much reliance upon residuals, and the apparent agreement of observations with a proposed theory, since it must be a very poor theory which will not accurately fit the known facts it was intended to explain. It is the subsequent observations which are dangerous to a preconceived theory. (*Monthly Notices*, LIII., 439.)

κ Pegasi. β 989. (p. 127.)

Since the orbit previously referred to was obtained, GLASENAPP has computed another (*Monthly Notices*, June, 1892, Vol. LII., p. 548), and finds the following elements:

$P = 11.54$ years.
$T = 1898.8$
$e = 0.20$
$a = 0''.21$
$i = 65°.98$
$\Omega = 125°.66$
$\lambda = 199°.9$

[Since the foregoing was written, I have re-investigated the orbit of this pair, using all the measures made by me at Mount Hamilton, and also two observations kindly made at my request by Prof. BARNARD with the 36-inch refractor. I get the following elements:]

$P = 11.37$ years.
$T = 1886.0$
$e = 0.40$
$a = 0''.29$
$i = 77°.5$
$\Omega = 109°.2$
$\lambda = 106°.1$

Apparent Orbit.

Length of major axis	$= 0''.54$
Length of minor axis	$= 0''.13$
Angle of major axis	$= 110°.0$
Angle of periastron	$= 326°.0$
Distance of star from center	$= 0''.04$

37 Pegasi. Σ 2912. (p. 132.)

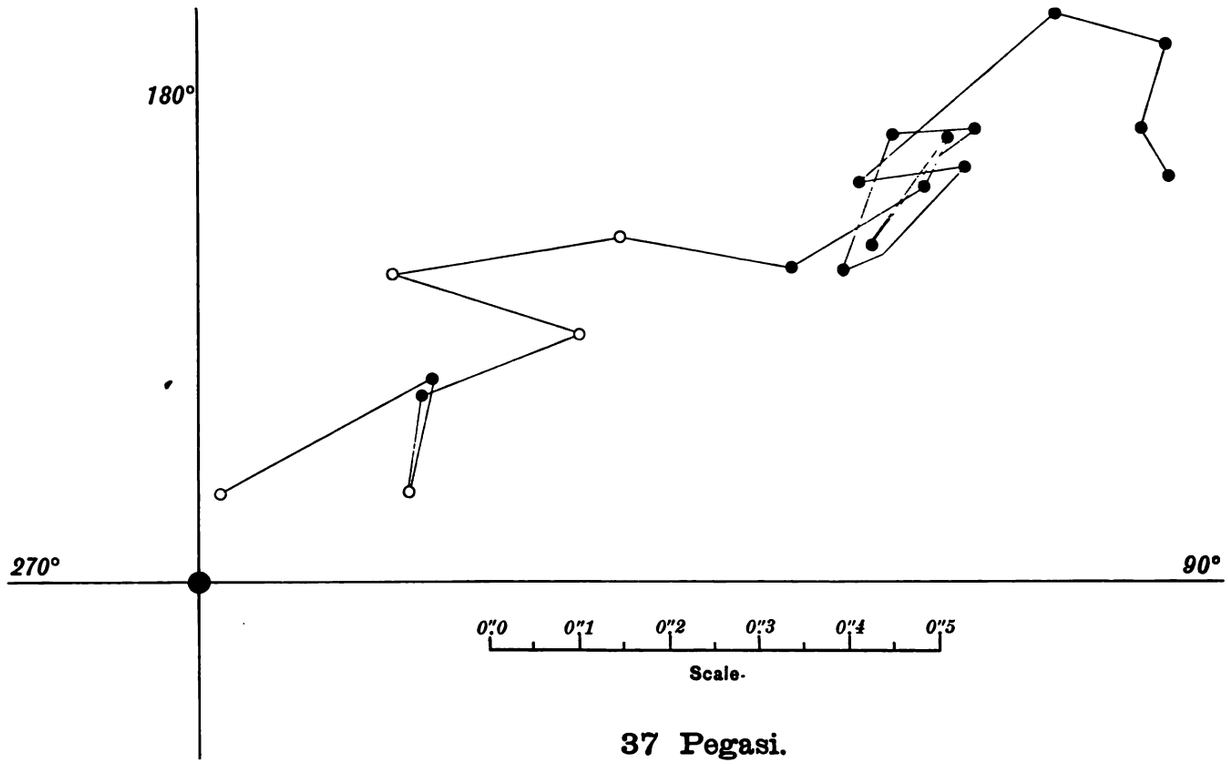
This pair has long been recognized as a binary system, but until recently no orbit has been attempted. For the half century following the first measures by STRUVE, the change in the components was substantially all in the distance, which has been steadily diminishing during the whole time. For many years past it has been a very difficult pair, and has often been noted as single. An inspection of the measures shows that until recently the two stars must have been separated by what would be a measurable distance in the largest refractors, though in some of the smaller instruments the elongation would be difficult to detect.

The last measure of this pair was made by me at Mount Hamilton in 1890, with the 36-inch refractor. The distance at that time certainly did not exceed $0''.1$. After these measures were made, Mr. GORE computed the orbit (A. N. 3129), and found a period of 117.54 years. As all the measures between 1831 and 1890 had put the smaller star in the second quadrant, this orbit necessarily depended upon my position in 1890, where the companion was placed in the fourth quadrant. I examined this pair on one night in 1889, with the 36-inch, and noted it as single. In the following year I observed it on two nights, and obtained fairly good measures of the angle, the distance being estimated at $0''.1$ or less. It was obvious that if an occultation had taken place, the companion could no longer be in the second quadrant, and therefore the angle was given in my observations as $347°.0$. A difference in the components of a little more than one magnitude would not be apparent in so close a pair. In the following year (1891) I expected the distance would be increased so that it could be measured without difficulty, but when it was examined under very favorable circumstances with the 36-inch, I found that it was practically single (A. N. 3114). There was no certain elongation on three first-class nights.

It follows, therefore, that the position-angle in 1890 should have been $167°.0$, and not $347°.0$, as I have given it in my measures (A. N. 3048). Mr. GORE was doubtless misled by my observations in 1889 and 1890, and assumed, as I did, that the companion had passed around to the opposite quadrant, giving a total angular motion of at least 230° in the sixty years covered by the measures. This would have been sufficient for the determination of a good approximate orbit. It is very probable that my failure in 1889, when the distance could not have been much more than $0''.1$, to notice any elongation, and hence calling it single, was a mistake, since it was very carefully observed in 1891; and therefore, until the companion reappears, no investigation of the relative motion can be made. It is impossible to predict the time when this will probably occur, or whether it will be in the third, fourth, or first quadrant. Down to this time the motion is practically rectilinear, and the apparent ellipse, so far as appears, may be either exceedingly eccentric, or the projection of a circular orbit, lying nearly in the line of sight.

The following are the observations of this pair:

1830–31	132°.2?	$1''.0 \pm$	1 n	J. Herschel
1831.12*	112.6	1.16	3 n	Struve
1835.67*	115.6	1.15	2 n	Struve
1839.69	119.0	1.22	1 n	Dawes
1841.64	106.2	0.65	2 n	Madler
1841.65*	123.5	1.13	1 n	O. Struve
1841.88	118.1	. . .	2 n	Dawes
1842.80*	121.1	0.85	3 n	Madler
1843.65*	120.1	0.82	2 n	Madler
1843.85*	116.7	1.11	2 n	Dawes
1845.51*	115.8	0.79	1 n	Madler



37 Pegasi.

1847.57*	121.°8	0.″97	1 n	Mitchell
1847.98*	123.9	0.85	1 n	Madler
1851.85*	126.2	0.67	2-1 n	Madler
1851.89*	114.4	1.31	1 n	W. Struve
1852.67*	116.4	0.83	1 n	O. Struve
1853.88*	118.7	1.11	1 n	Dawes
1853.94*	122.8	0.81	1 n	Madler
1854.74*	118.5	0.91	3 n	Dawes
1854.78	114.2	...	1 n	Madler
1855.82	118.4	...	1 n	Madler
1856.78	127.7	0.6 ±	1 n	Madler
1857.09*	117.9	0.74	4 n	Secchi
1857.87	116.3	0.7 ±	2 n	Jacob
1858.00	128.2	...	2 n	Madler
1859.87*	129.3	0.6 ±	1 n	Madler
1860.69	119.8	...	1 n	Dawes
1861.98*	148.0	0.4 ±	2 n	Madler
1863.66	113.2	...	3 n	Dembowski
1866.71	99.1	0.5 ±	2 n	Winlock
1866.67	96.6	0.5 ±	1 n	Searle
1866.69	132.9	...	1 n	Searle
1866.76	116.4	...	1 n	Searle
1867.65	111.8	oval	1 n	Dembowski
1868.76	138.0	...	1 n	C. S. Pierce
1869.67	132.0	...	1 n	C. S. Pierce
1869.75	114.8	...	1 n	C. S. Pierce
1871.92	122.3	0.5 ±	1 n	Wilson & S.
1872.56	116.7	obl.	1 n	Dembowski
1873.78*	119.3	0.5 ±	1 n	Wilson & S.
1873.87*	119.6	0.5 ±	1 n	Gledhill
1873.88*	130.6	oval	1 n	Dembowski
1875.77	...	invisible	...	Doberck
1877.75	118.°8	0.″3?	1 n	Dembowski
1878.63*	130.0	0.32	1 n	Burnham
1879.57*	113.4	0.25	1 n	Burnham
1879.86	128.3	...	1 n	Seabroke
1880.59	...	single	1 n	Burnham
1885.53*	131.4	0.34	5 n	Engelmann
1885.72	...	single	2 n	Perrotin
1889.59	...	single?	1 n	Burnham
1890.56*	167.0	0.1 ±	2 n	Burnham
1891.64	...	single	3 n	Burnham

LEAVENWORTH has a measure made in 1886 (*Publications of the McCormick Observatory*, Vol. I, Part 4), which is credited to this pair, but it obviously belongs to β 291, a close pair in the immediate vicinity of 37 *Pegasi*.

The relative change in the components will be seen from the accompanying diagram, on which the principal measures are laid down to scale. These measures are marked with a (*) in the preceding list. When two or more observations, made in the same year, are used, a simple mean is taken.

The tendency of the observed positions to arrange themselves in groups, which, as I have heretofore shown, is always found in stars of this class, where the relative motion is small compared with the errors of observation, is well marked in this instance.

LIST OF THE CATALOGUES OF NEW DOUBLE STARS DISCOVERED BY S. W. BURNHAM.

FIRST CATALOGUE, Nos 1 to 81. *Monthly Notices of the Royal Astronomical Society*, March, 1873. Vol. XXXIII., 351.

SECOND CATALOGUE, Nos. 82 to 106. *Monthly Notices R. A. S.*, May, 1873. Vol. XXXIII., 437.

THIRD CATALOGUE, Nos. 107 to 182. *Monthly Notices R. A. S.*, December, 1873. Vol. XXXIV., 59.

FOURTH CATALOGUE, Nos. 183 to 229. *Monthly Notices R. A. S.*, June, 1874. Vol. XXXIV., 382.

FIFTH CATALOGUE, Nos. 230 to 300. *Monthly Notices R. A. S.*, November, 1874. Vol. XXXV., 31.

SIXTH CATALOGUE, Nos. 301 to 390. *Astronomische Nachrichten*, No. 2062.

SEVENTH CATALOGUE, Nos. 391 to 436. *Astronomische Nachrichten*, No. 2103.

EIGHTH CATALOGUE, Nos. 437 to 452. *American Journal of Science*, July, 1877.

NINTH CATALOGUE, Nos. 453 to 482. *Monthly Notices R. A. S.*, December, 1877. Vol. XXXVIII., 78.

TENTH CATALOGUE, Nos. 483 to 733. *Memoirs of the Royal Astronomical Society*, Vol. XLIV.

ELEVENTH CATALOGUE, Nos. 734 to 775. *Report to the Trustees of the James Lick Trust, of observations made on Mount Hamilton, with reference to location of the Lick Observatory*, 1879. (Reprinted in *Publications of the Lick Observatory*, Vol. I., 1887.)

TWELFTH CATALOGUE, Nos. 776 to 863. *Publications of the Washburn Observatory*, Vol. I.

THIRTEENTH CATALOGUE, Nos. 864 to 1025. *Memoirs of the Royal Astronomical Society*, Vol. XLVII.

FOURTEENTH CATALOGUE, Nos. 1026 to 1038. *Astronomische Nachrichten*, No. 2875.

FIFTEENTH CATALOGUE, Nos. 1039 to 1092. *Astronomische Nachrichten*, Nos. 2929–30.

SIXTEENTH CATALOGUE, Nos. 1093 to 1154. *Astronomische Nachrichten*, Nos. 2956–57.

SEVENTEENTH CATALOGUE, Nos. 1155 to 1224. *Astronomische Nachrichten*, Nos. 3047–48.

EIGHTEENTH CATALOGUE, Nos. 1225 to 1266. *Astronomische Nachrichten*, Nos. 3113–14.

NINETEENTH CATALOGUE, Nos. 1267 to 1274. *Astronomische Nachrichten*, Nos. 3141–42.

*** The last six catalogues are included in the present volume.

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*** It is intended to issue, at irregular intervals, two series of works, the first, in quarto, to be known as *Publications* of the Lick Observatory; the second, in octavo, to be known as *Contributions* from the Lick Observatory. Occasional pamphlets, such as No. 2 below, may not be included in either series. At the end of every book a list of all the works issued will be given, for the convenience of librarians and others.

For the sake of uniformity, Nos. 3 and 4 below will be counted as *Contributions* Nos. 1 and 2.

1. *Publications* of the Lick Observatory of the University of California, prepared under the direction of the Lick Trustees by EDWARD S. HOLDEN. Volume I., 1887. Sacramento, 1887. 4to. [Containing a brief history of the Observatory, with descriptions of the buildings and instruments; Observations of double stars, by S. W. BURNHAM, 1879; of the Transit of *Mercury*, 1881, by Messrs. FLOYD, HOLDEN, and BURNHAM; of the Transit of *Venus*, 1882, by D. P. TODD; Meteorological Observations, by T. E. FRASER, 1880–85; and Reduction Tables for Mt. Hamilton, by G. E. COMSTOCK.]

2. Suggestions for Observing the Total Eclipse of the Sun on January 1, 1889, by EDWARD S. HOLDEN. Printed by authority of the Regents of the University of California. Sacramento, 1889. 8vo. [Out of print.]

3. *Contributions* from the Lick Observatory, No. 1. Reports on the Observations of the Total Eclipse of the Sun of January 1, 1889. Published by the Lick Observatory. Printed by authority of the Regents of the University of California. Sacramento, 1889. 8vo. [Out of print.]

4. *Contributions* from the Lick Observatory, No. 2. Reports on the Observations of the Total Eclipse of the Sun, December 21–22, 1889, and of the Total Eclipse of the Moon, July 22, 1888, to which is added a Catalogue of the Library. Published by the Lick Observatory. Printed by authority of the Regents of the University of California. Sacramento, 1891. 8vo. [Out of print.]

5. *Contributions* from the Lick Observatory, No. 3. Terrestrial Atmospheric Absorption of the Photographic Rays of Light, by J. M. SCHAEBERLE, Astronomer in the Lick Observatory. Printed by authority of the Regents of the University of California. Sacramento, 1893. 8vo.

6. *Publications* of the Lick Observatory of the University of California. Printed by authority of the Regents of the University. Volume II., 1894. Sacramento, 1894. 4to. [Containing double star observations made with the 36-inch and 12-inch refractors of the Lick Observatory from August, 1888, to June, 1892, by S. W. BURNHAM.]